WORKSHOP ON ENVIRONMENTAL HEALTH

Bengaluru
22-23 January 2008

Intervention Programme for Mitigating Air Pollution Related Health Risks

PROCEEDINGS

BRUHAT BANGALORE MAHANAGARA PALIKE

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Bengaluru, 22-23 January 2008

Intervention Programme for Mitigating Air Pollution Related Health Risks

PROCEEDINGS

Proceedings of
Workshop on Environmental Health

Intervention Programme for Mitigating Air Pollution Related Health Risks

22 – 23 January 2008

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In association with volunteers from
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Bengaluru

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Preface

The Bengaluru Environmental Health workshop held on 22-23 January 2008 at the Karnataka State Control Board auditorium at Church Street was one in a series, initiated by Cerana Foundation two years ago.

The focus of this workshop series was on health effects of air pollution on urban populations. Air pollution in India is estimated to cause at the very minimum, one lakh deaths and another 250 lakh cases of serious sickness per year. Even these conservative estimates indicate that more Indians die of air pollution than of all other non natural causes put together. The only other major causes of human induced mass death are industrial and transport accidents and wars. Yet scant attention has been paid to the problem of pollution.

The theme of the Bangalore workshop was *"What more needs to be done to win the war against air pollution related health risks in Bengaluru?"* Its aim was to equip the citizens of Bengaluru to rid this once beautiful garden city of air pollution, its worst bane which severely affects the health of 10% of its 60 lakh population and 50% of its children below 18 years. This is one of the inevitable consequences of rapid and unplanned growth of the city, excess vehicular traffic, (1500 new vehicles are registered daily), industrial emissions, refuse burning in garbage dumps and several other seemingly regular activities that urban life entails.

The workshop was designed to:

- Inform participants about air pollution related health issues pertinent to Bengaluru.
- Facilitate participants to formulate holistic interventions that they can implement on their own.
- Encourage partnerships among participants and create an informal structure for implementation.
- Make risk bearers, particularly those at high risk, a central part of plan formulation and implementation.

In order to secure a broad spectrum of stake holders that can tackle the issue effectively, a few national level organizations and several local organizations and groups were invited to co-sponsor the workshop. These included central and state government organizations, health care delivery units, professional and development organizations and trade unions.

Approximately 30% of the registered participants at the workshop were doctors, 15% were officials from various government departments, 35% were community health workers, members of NGOs and trade unions and 20% comprised a mix of individuals from different walks of life like Law, Media, Town planning, students of environmental sciences and concerned citizens.

Follow up action

At the end of the workshop it was decided to set up an ad hoc citizen's committee that would decide on the action programme required, to take the outcome of the workshop forward.

It was conveyed by the Secretary, Department of Ecology and Environment, Karnataka Government, in the concluding session of the workshop that the state government's Bengaluru Task Force on Air Pollution Mitigation may consider co-opting a representative from the citizen's committee.

Workshop Agenda

22 Jan 2008	**Day 1**
Venue	**KSPCB Auditorium, Church Street, Bengaluru**
9.00-10.00	**Registration & networking**
10.00-10.45	**Inaugural session**
	Speakers: Mr Sagar Dhara, Cerana Foundation, Welcome address Dr H C Sharatchandra, Karnataka State Pollution Control Board, Presidential remarks Mr Surendra Shrestha, United Nations Environmental Programme, Keynote address Mr R Rajamani, Retired civil servant, Ministry of Environment and Forests, Facilitator's remarks Mr B Venkatesh, KSPCB, Vote of thanks
10.45-11.00	**Tea**
11.00-13.00	**Plenary session 1: Air pollution-related health risks**
	Chair: Dr G K Jayaram, Institute of Leadership and Institutional Development
	Speakers: Mr Mylvakanam Iyngarasan, UNEP, Learning from South-east Asian experiences in tackling air pollution Dr. Paramesh, Lakeside Hospital, Air Pollution and Children's Health Dr Sukanya Rangamani, Community Health Cell, Community Health and air pollution: Community action to reduce environmental health risks Dr B Nagappa, KSPCB, Ambient Air Pollution in Bengaluru Ms Dhenuka Srinivasan, The Energy and Resource Centre, Indoor Air Pollution and its Management
	Discussion
13.00-13.45	**Lunch**

13.45-15.45 **Plenary session 2: Current responses and challenges to air pollution-related health risks**

Chair:

Dr R Mahesh Babu, Consulting physician

Speakers:

Mr Anand Rao, Bangalore Metropolitan Transport Corporation, Traffic planning for Better Air Quality in Bengaluru

Mr M D N Simha, KSPCB, Air Quality Monitoring and Regulation in Bengaluru: Current and Future Programmes

Dr George D'Souza, St John's Hospital, Asthma, Lung Disease, Lung Function, Surveillance and Pollution

Testimonies of affected persons: Quarry worker, Garbage worker, Garment worker, Ms Jayashree, QWARIDS, Has the system been able to respond to the plight of *"aam admi" who is affected by air pollution?*

Discussion

15.45-16.00 **Tea**

16.00-17.30 **Plenary session 3: Other experiences and broader issues**

Chair:

Mr. Paritosh Tyagi, Retired civil servant, Central Pollution Control Board

Speakers:

Dr A Venkatachalam, Consulting ophthalmic surgeon, Effects of Air Pollution on Eye

Prof S Shivkumar, M S Ramaiah Institute of Technology, Implications of Urban Planning on Air Pollution Related Health Risks

Dr Rajendra Prasad, Indian Association of Air Pollution Control, Have Air Quality Standards Helped in Mitigating Air Pollution Related Health Risks?

Mr Sagar Dhara, Cerana Foundation, Local and Global Air Pollution, Two Sides of the Same Coin That Can Only Be Tackled Together and Through Equity in Carbon Emissions.

Discussion

23 Jan 2008	**Day 2**
9.00-9.30	**Briefing on breakout sessions: Deliverables and methodology**
9.30-11.15	**Breakout session 1: Review of existing risk mitigation plans (if relevant), preparing additional plans that can be implemented by workshop participants** Group 1: Health Effects Management for all Spaces Facilitators: Athar Qureshi, Priya Patel Group 2: Ambient Air Quality Management for Work and Indoor Spaces Facilitators: S. K. Gupta, C. J. Chander Group 3: Air Quality Management in Work and Indoor Space Facilitators: Vinay Kumar, Sukanya Rangamani Group 4: Community Intervention Programmes Facilitators: Premdas, Vinay Vishwanath
11.15-11.30	**Tea**
11.30-13.15	**Breakout session 2: Phasing and costing of plans** The groups remain the same as in Breakout session 1
13.15-14.00	**Lunch**
14.00-15.00	**Plenary session 4: Panel discussion: What more do we need to do to win the war against air pollution in Bengaluru?** **Moderator:** Mr S K Gupta, Indian Association of Air Pollution Control **Panelists:** Mr H Srinivasiah, Factories Inspectorate, Government of Karnataka Mr Arvind Jannu, Department of Environment and Ecology, Government of Karnataka Mr P H Rane, Traffic Department, Bengaluru Police Mr Govinda Raj, Bruhat Bengaluru Mahanagara Palike Dr Jagdish Chinappa, Indian Association of Pediatrics Mr V N Subba Rao, Karnataka Media Academy

13.15-15.00	**Synthesis of the different plans by group representatives**
15.00-15.15	**Tea**
15.15-16.15	**Presentation of plans, general discussion and forming ad hoc Co ordination committee for intervention work in Bengaluru**

Chair:

Mr R Rajamani, Retired civil servant, MoEF

Brief presentations by representatives

Discussion

16.15-16.45	**Valedictory session: Conclusions**

Chair:

Mr R Rajamani, Retired civil servant, MoEF

Speakers:

Mr. Arvind Jannu, Air Quality Management Task Force for Bengaluru, Government of Karnataka

Mr Mylvakanam Iyngararasan, UNEP

Dr H C Sharatchandra, KSPCB

Mr T Vijayendra, Cerana Foundation, Vote of thanks

Inaugural Session

Mr. Sagar Dhara, *Director,* Cerana Foundation.

What more needs to be done by Bengaluru citizens to win the war against air pollution?

Mr Surendra Sreshtha, Regional Director UNEP, Dr Sharatchandra, Chairman, Karnataka State Pollution Control Board, Mr Rajamani, Former Secretary, Ministry of Environment and Forests, Mr Venkatesh, Member Secretary, Karnataka State Pollution Control Board, and distinguished guests and participants:

I take great pleasure in welcoming all of you to Bengaluru, and to this Workshop on environmental health: Intervention programmes for mitigating air pollution related health effects. For those of you who had to battle the city traffic to be here at the workshop today, I hope you had a reasonably uneventful and smooth ride.

Alas, this city, once known as the garden city, has now come to be known as the asthma capital of India. Air pollution, caused by rapid unplanned growth of the city and vehicle over-population are Bengaluru's worst bane, and are responsible for the city's fall from grace.

Air pollution related health risks in Bengaluru: Every second or third family in Bengaluru has an asthmatic. In many ways, Bengaluru prides itself in leading India. I hope that air pollution is one field where Bengulurians decide that they do not wish to lead India.

Workshop theme: Soon after we began preparing for this workshop, I was happy to learn that the Government of Karnataka has already set up a Task Force to tackle the problem of air pollution in Bengaluru. The objective of this workshop is to have civil society to become proactive about tackling air pollution related health risks; and build partnerships and coalitions with all those, including government, attempting to solve them. The workshop's theme: ***"What more needs to be done by Bengaluru's citizens to win the war against air pollution?"***, challenges ordinary Bengaluru citizens and other stakeholders, along with doctors, air quality managers, community health workers, the media, and all of us, to make intervention plans that we ourselves can implement to cleanup this city.

Three key factors to win the war against air pollution: The workshop recognizes three key requisites to win the war against air pollution: a) Preparing integrated intervention plans for tackling air pollution related health risks, b) Forming coalitions and partnerships of various stakeholders, c) Making the risk-bearer an important and integral part of the solution.

- **Preparing integrated intervention plans for tackling air pollution related health risks:** Thus far, those working on various aspects of reducing risks caused by air pollution have been working in relative isolation. The workshop recognizes that the need of the hour is to develop holistic and integrated solutions that link the local issues to global ones. For example, it is necessary for an asthmatic to keep her home clean from dust and other asthma triggers. But that is inadequate. The local community health worker needs to know who the asthmatics in her beat area are, and what to do in the event of an asthma emergency. Hospitals must be geared to identify and tackle the problem medically to save lives and reduce suffering. But to beat asthma and other air pollution related illnesses, the workplace and the ambient environments must be cleaned up. This brings into the picture work space owners, government regulators, architects, town planners, unions, residents, bystander population associations, and transport and traffic departments. That means just about everybody. It is interesting to note that this workshop has tried to get together a diverse set of people to tackle this problem.
- **Form coalitions and partnerships of various stakeholders:** Obviously, such integrated intervention plans can only be implemented through coalitions and partnerships formed by various stakeholders. The workshop recognizes this.
- **Making the risk-bearer an important and integral part of the solution:** Lastly, and most importantly, if the risk bearer is not motivated to do anything about his problem, there is not much that others can or will do to reduce his risk. By involving community health workers, the workshop is bringing onboard the risk bearers to become a central part of the solution, and not remain an object that others experiment with.

- **Emphasis on solving problems together, not just stating them:** This workshop is unique in two respects. First, it will not attempt to merely state the problems in a *talking heads* format, second, it will try to get creative and motivated people to start searching for solutions that they will formulate and take responsibility for implementing.
- **Involvement of the local to the global:** The workshop has participants who are quarry and construction workers, doctors, engineers, community health workers, government officials and even UNEP. This is truly trying to bridge the gap between the local and global levels—so very necessary to tackle this problem.

Workshop was a multi-partner effort: It is very heartening to see so many organizations, government, professional and civil society come together to organize this workshop. *UNEP* sponsored the workshop, *Cerana Foundation* organized the workshop in association with *Karnataka State Pollution Control Board*, and a host of other organizations—*Central Pollution Control Board, Indian Association of Air Pollution Control, Public Health Foundation of India, Bruhat Bangalore Mahanagara Palike, Bangalore Medical College and Research Institute, Community Health Cell, St John's National Academy of Health Sciences, Voluntary Health Association of Karnataka, Indian Academy of Paediatricians, CREDITTe, Janajagruthi Samithi, Samarthan, Church of South India Hospital, ILID, Indian Association of Occupational Health (Karnataka Branch), and the Quarry Workers & Rural Integrated Development Society,* have co-sponsored the workshop, thus taking collective ownership of it. It really shows a spirit of cooperation, something so necessary for tackling health risks caused by air pollution. I thank all of them for the wonderful cooperation that they gave us.

Bengaluru can show the way: The cost of the burden of disease caused by air pollution is colossal. Air pollution causes, at the very minimum, one lakh Indians to die and another 250 lakh Indians to fall sick every year. WHO estimates state that each year 2.4 million people die worldwide, from causes attributable to air pollution. Asthma, just one of the health risks associated with air pollution affects 300 million people (5% of the world's) population. If other diseases like chronic obstructive pulmonary disease, chronic bronchitis, eye and heart diseases, and allergies were added, the burden of disease would be much larger.

With the cooperation forged in this workshop, I hope that Bengaluru will not only take a lead in solving its air pollution problems, but also show the way for the rest of India, and in fact the world. So, let us collectively make this workshop a very fruitful event for ourselves and for Bengaluru as well.

Dr. Sharat Chandra, *Chairperson,* Karnataka State Pollution Control Board.

The problem lies in the general lack of awareness regarding the ill effects of air pollution. The workshop will help fill the knowledge gap that seems to exist amongst the general public regarding health risks connected to air pollution and alleviation measures for the same.

A problem as large as this can only be solved by a methodical and methodological approach. There is need to work towards some kind of comprehension of the biological mechanisms of the ways in which air pollution affects health. There has to be a sustained effort to gather epidemiological evidences so that curative and preventive measures may be created.

As there are only a limited number of available 'Air Pollution Design' programs and set standards, policy makers, scientists and citizens should all come together to offer concrete suggestions to tackle the problem.

Mr. Surendra Shrestha, *Regional Director, Asia Pacific Region,* United Nations Environment Programme.

It was after the Stockholm conference of the UN in 1972 that the UNEP was established. It took another two decades of global campaigning and pressurizing to get NGOs and Government bodies to pay heed to the issue of environment and to bring them to recognize it as a matter of top priority. Currently 15 billion dollars are being spent by UNEP on the issue of Environment and Climate Change.

I am happy to inform you that of the 6 priority programme of the UNEP, two are on climate change and one on biodiversity. In implementing these UNEP considers the scientific community as its natural ally.

The existing UNEP office in the Asia Pacific region is under pressure from several governments to broaden its network and intensify its operations at the level of individual nations. Environment is on the priority list of all ASEAN nations and many of them already have dedicated ministries to address their growing concerns about sustainable development in the face of rapidly expanding economies. Regional collaborations and partnerships amongst the 180 governments of the region are advisable as that will further facilitate efforts towards sustainable development.

The United Nations Framework Convention on Climate Change hopes to contribute to sustainable development by supporting action to mitigate and to adapt to climate change at the global, regional and international levels.

The Intergovernmental Panel on Climate Change, a scientific body set up in 1988 by UNEP and the World Meteorological Organization (WMO) to provide the decision-makers and others interested in climate change with an objective source of information about climate change, is bringing a 4th report.

The President of France has recently announced a Ministry of Happiness and other countries are also looking at the Happiness and well being quotient of their citizens.Climate change related issues like sea level rise, melting glaciers have begun to draw the attention of economists as it is becoming evident that these are likely to impact life more than has been grasped thus far. While Australia's move to sign the Kyoto Protocol has been applauded there has been general disapproval about America's reservations in signing it although Americans have grown aware of environmental issues.

Mr. R. Rajamani, *Retired civil servant, MoEF.*

No programme can succeed without the contribution of citizens.

The currently existing epidemiological studies related to pollution induced diseases are insufficient and the medical community needs to conduct more.

Instead of 'mitigating', all interventions should talk of and aim at 'eliminating' pollution and disorders caused by it although environmental scientists claim that 100% elimination of pollution is not possible.

Environmentally sustainable modes of transport will be a major step in the direction of improving environmental quality.

By providing information on air quality, Google Earth and other sites can enable people to plan healthy travel.

Disseminating information in a large country like India is difficult but that can be resolved through widespread involvement of citizens who will share the responsibility with the government.

At the Mumbai asthma workshop in 2005, a number of interventions had been discussed and an action plan was prepared. A booklet containing advice for children and families was also released subsequently.

Something similar should be attempted in this workshop.

Mr. B. Venkatesh of KSPCB thanked the panel for their presentations and closed the Inaugural session.

Plenary Session 1:
Air pollution related health risks

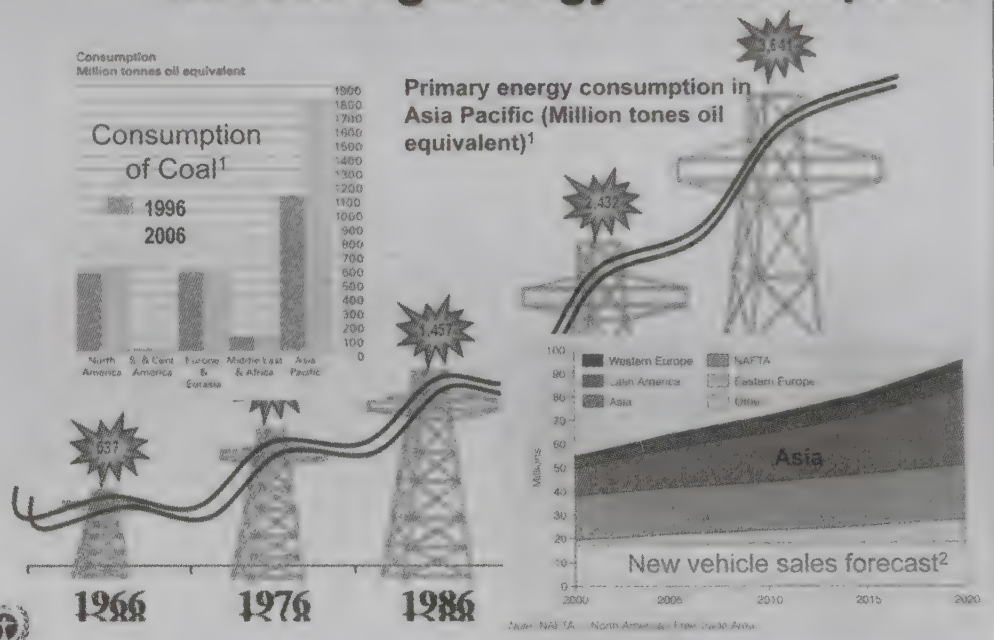
Chair: Dr G K Jayaram
Founder Director
Institute of Leadership and Institutional Development

In 1970, I attended a global conference which discussed the 'Limits to Growth'. The issue being debated was that growth may become harmful so it should be restrained. The debate was polarized between developed and developing countries had the former declaring that growth should be restrained while the latter understandably argued that, it's easier for people with filled their bellies to say "control your needs" to their less fortunate brethren. Back then global warming and climate change were non issues. Thirty years down the lane environmental issues have become imperative and not merely desirable. If they are held as optional subjects for discussion, there will be no next generation.

Air Pollution and Human Health

UNEP

Increasing Energy Consumption



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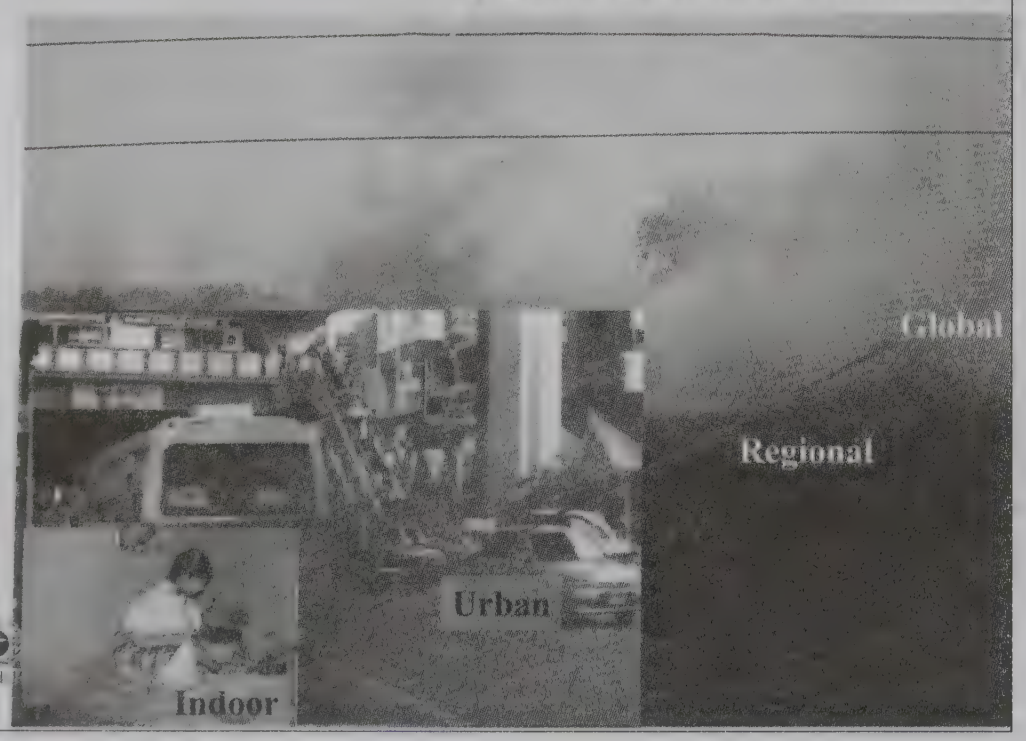
Source. Energy in focus – BP Statistical review of World Energy, 2007 2. SEI (2003)

Scale of Air Pollution



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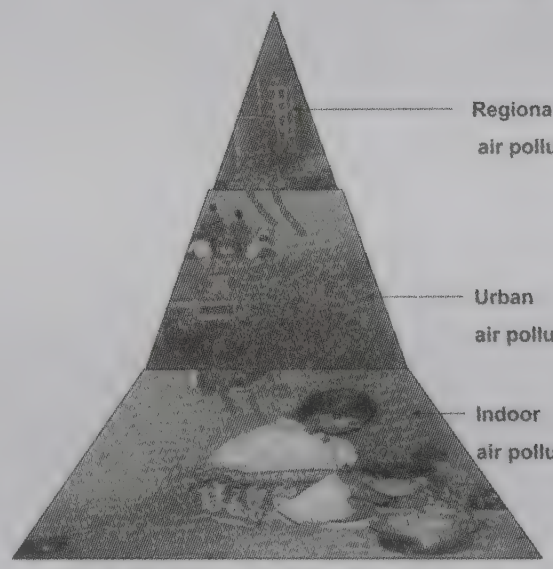
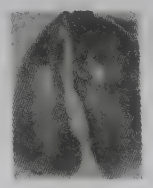
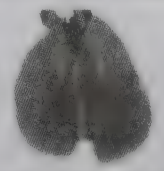
Scale of air pollution…





Exposed to diesel exhaust[1]



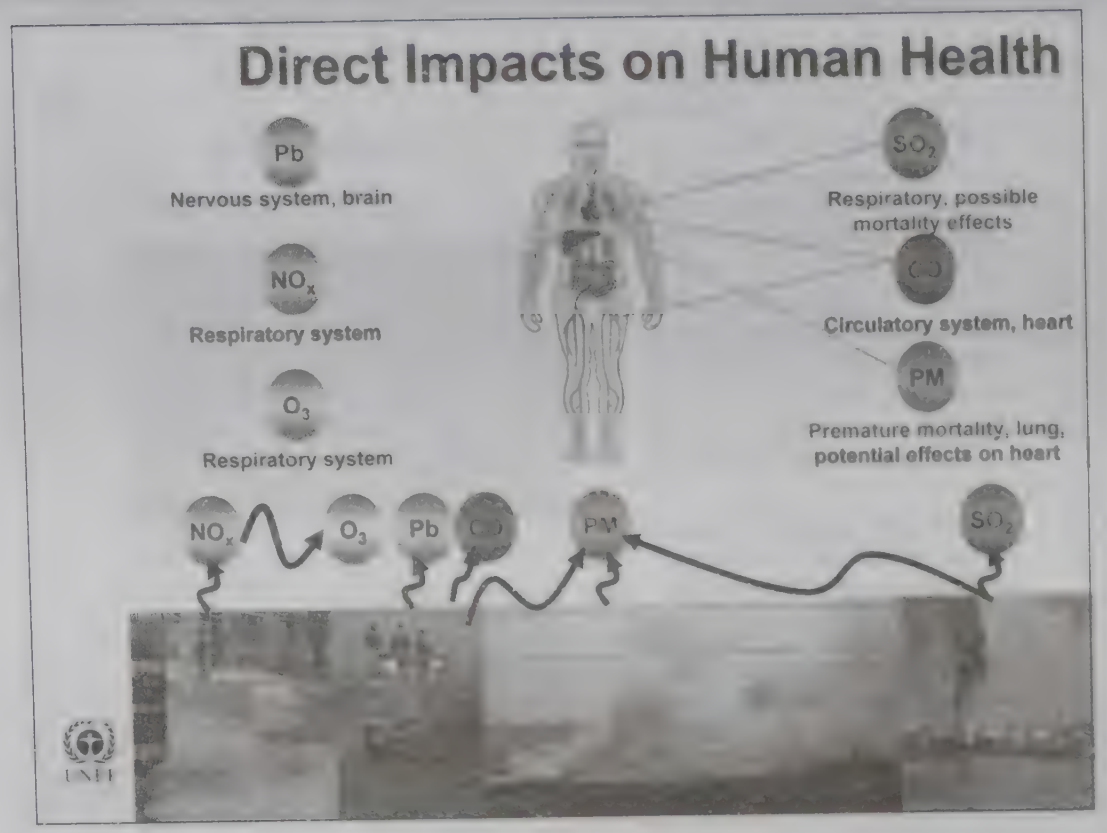
Exposed to clean air[1]

UNEP

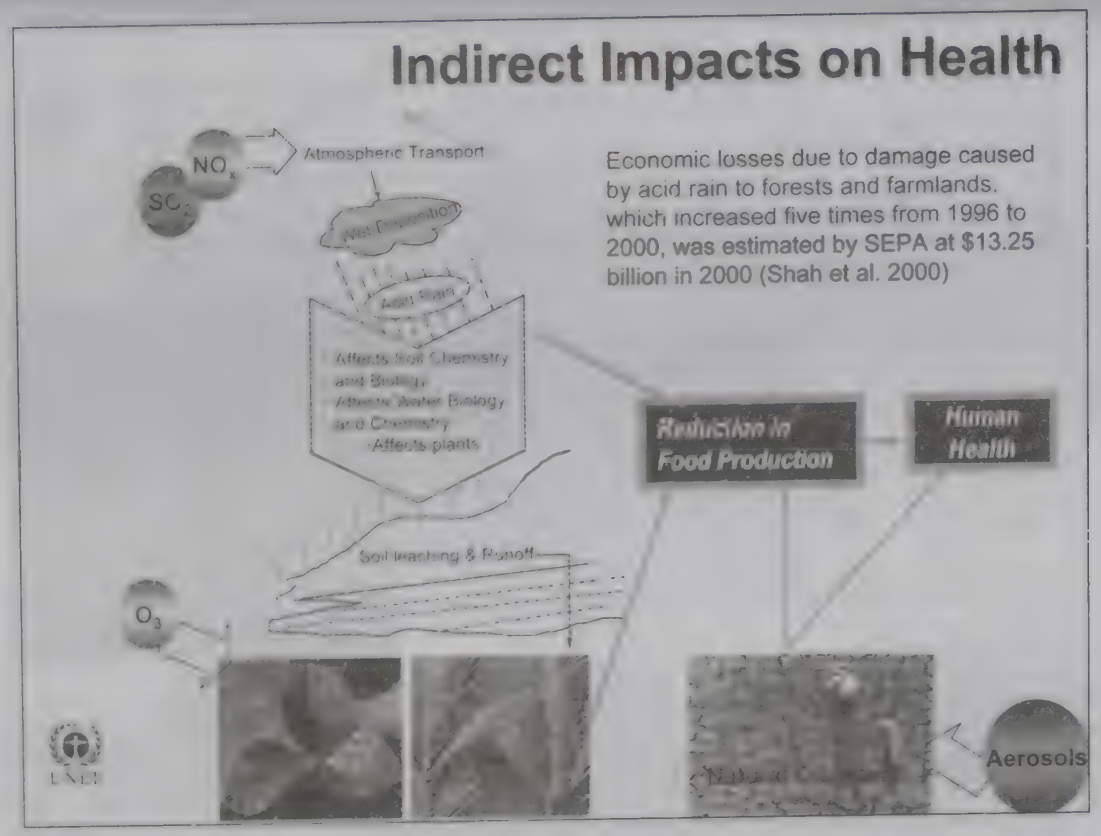
IPCC AR4: Health co-benefits from reduced air pollution as a result of actions to reduce GHG emissions can be substantial and may offset a substantial fraction of mitigation costs

Source: 1. NIES, www.nies.go.jp

Direct Impacts on Human Health



Indirect Impacts on Health



Economic losses due to damage caused by acid rain to forests and farmlands, which increased five times from 1996 to 2000, was estimated by SEPA at $13.25 billion in 2000 (Shah et al. 2000)

Initiative in Southeast and East Asian countries

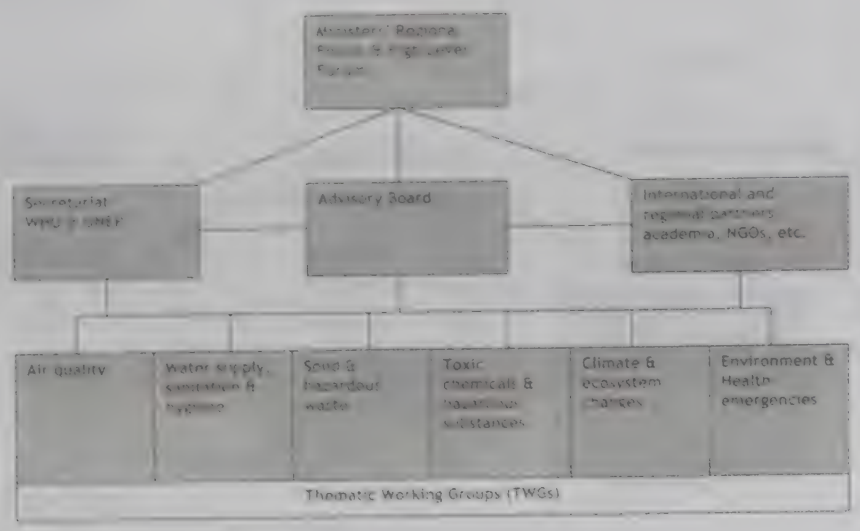
- The third High-Level meeting, August 2007 in Bangkok
- The first Ministerial Forum, August 2007 in Bangkok.

Regional Level
- Charter of the Regional Forum on environment and Health in Southeast and East Asian Countries - Framework for Cooperation
- Bangkok Declaration on Environment and Health

National Level
- National Environment Health Action Plan
- Collaboration between EIA and HIA

PARTICIPATING COUNTRIES
Brunei Darussalam, Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, and Vietnam

Initiative in Southeast and East Asian countries...



Male' Declaration in South Asia

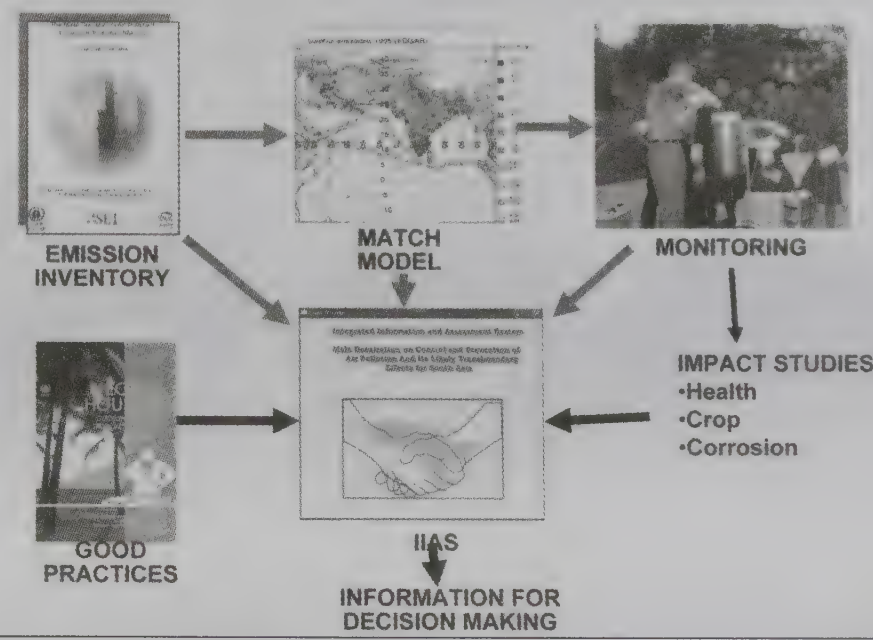
Development
- March 1998: Policy Dialogue
- April 1998: Adoption of the Declaration

Implementation
- Phase I: Awareness and preparation of the baseline information
- Phase II: Local capacity development for monitoring and analysis

Member states

UNEP

Activities of Male' Declaration



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Health Impact Study

Regional Training on Health Impact; February 2007, RRCAP, Bangkok

Regional Trainings on Health Impact Assessment; February 2007 and August 2007

- **Relationship between air quality and health in the participating countries of Malé Declaration**
- **Implementation of technical measures**
- **Policies which can effectively prevent and reduce the impact of air pollution on health.**
- **Assist participants to conduct assessments of the health effects of air pollution in their cities.**

Case study
Dhaka, Bangladesh

UNEP

Dhaka, Bangladesh

School Teachers and Children participating in the health impact assessment study, Dhaka, Bangladesh

	DBS	TGS	CAS	TOTAL
Sample class	V-IX	V-IX	V-IX	
Total students	720	600	500	1820
Total teachers	17	11	11	39
Doctors	2	2	2	6
Technician	1	1	1	3

	SCHOOL NAME			
Asthma	DBS	TGS	CAS	Total
No	30 (33.3%)	15 (33.3%)	15 (33.3%)	60 (33.3%)
Yes	60(66.7%)	30(66.7%)	30(66.7%)	120 (66.7%)
Total	90(100.0%)	45(100.0%)	45(100.0%)	180(100.0%)

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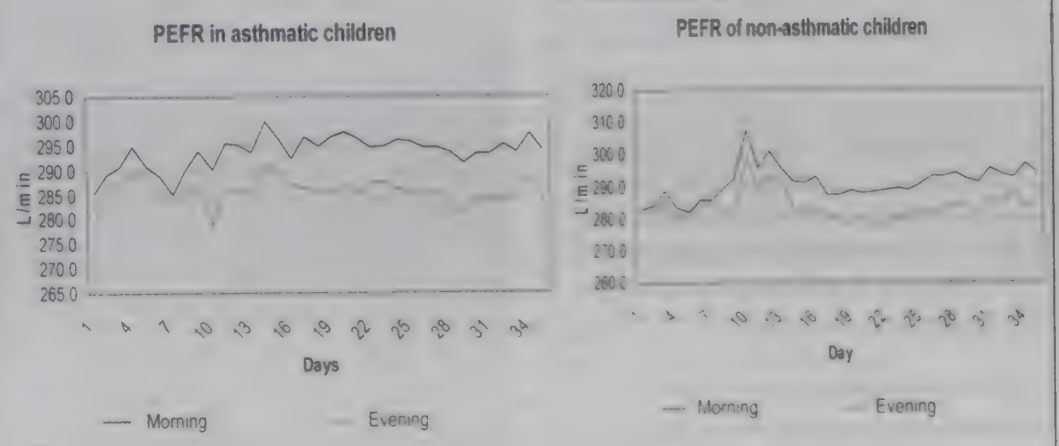
Dhaka, Bangladesh



- As the particulate matter concentration increases from morning to evening, the PEFR decreases from morning to evening for both asthmatic and non-asthmatic children.

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The Way forward

Air Pollution

- Monitoring
- Assessment
- Prevention and Control of Air Pollution

Human Health

- Treatment of illness
- Healthcare services

- Coordination among health and environmental agencies
- Information sharing
- Joint research on new and emerging issues

General Public

Eco-Housing

Eco-Mobility

UNEP

Air Pollution & Children's Health

Dr. H. Paramesh

MD, FAAP (USA), FIAP, FIAMS, FIAA, FICAAI

dr_paramesh1@yahoo.com

- Director, Pediatric Pulmonologist, Lakeside Hospital, Bangalore
- Past National Chairman, IAP Respiratory Chapter
- Past Founder Chairman, IAP Environment Group
- Board of Director, International Network of Children's Health, Environment and Safety, Amsterdam
- Member, Environment Monitoring Committee, Metro Rail, Bangalore

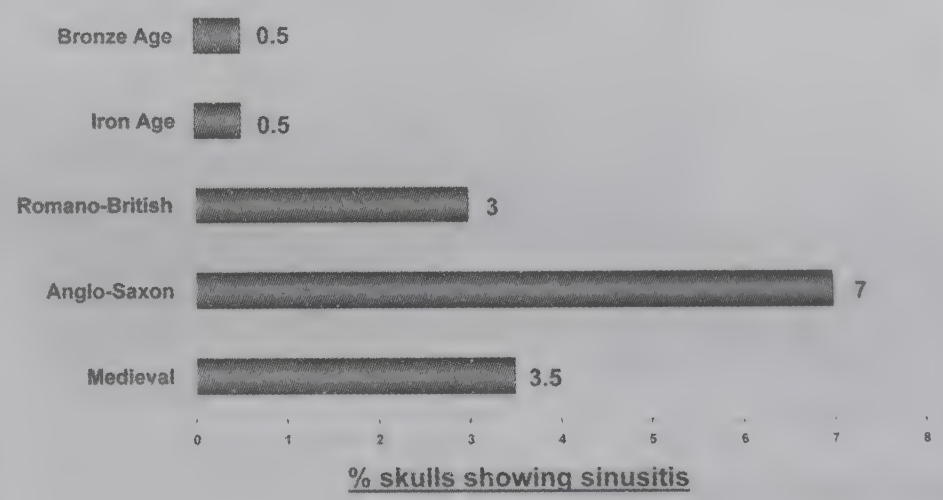
Importance of Environment on Children's Health

- Environmental hazards are among the top health concern globally and locally
- There is scant learning in Medical Colleges regarding Environmental hazards and its relation to illness
- Text books devote scant attention regarding Environmental issues on Children Health
- Information in specialty journals is hardly read by clinicians
- Ambient air pollution is a major health problem both nationally and globally
- Environment and Child Health group of I.A.P Started in the year 1999

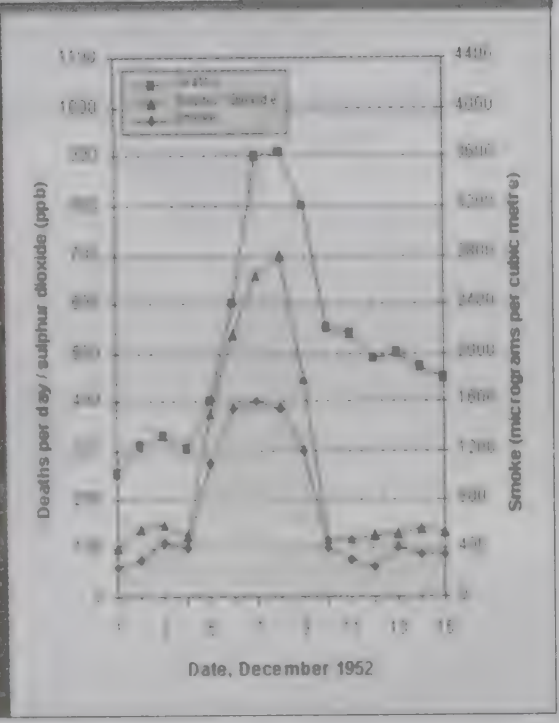
Why are Children Vulnerable to Environmental Pollution?

- **Lungs have highest surface area**
- **Breathe more air relative to body weight**
- **Increase physical activity 124min/day – adult(21min)**
- **5 times more deposition of particles during activity**
- **Small airways favour deposition**
- **Time spent outdoor 2.8hr/day: Indoor 19hr/day (3-5yrs)**
- Oral intake of soil and dust - 790mg/day (2-7 yrs)
- Mouthing behaviour 25.8min/day up to 6 yrs; 55min (10 – 60 yrs) (Hand/fomite to mouth)
- Community water intake 25ml/kg/day (1-5 yrs)

Sinusitis Frequency in Britain Through the Ages



London Smog

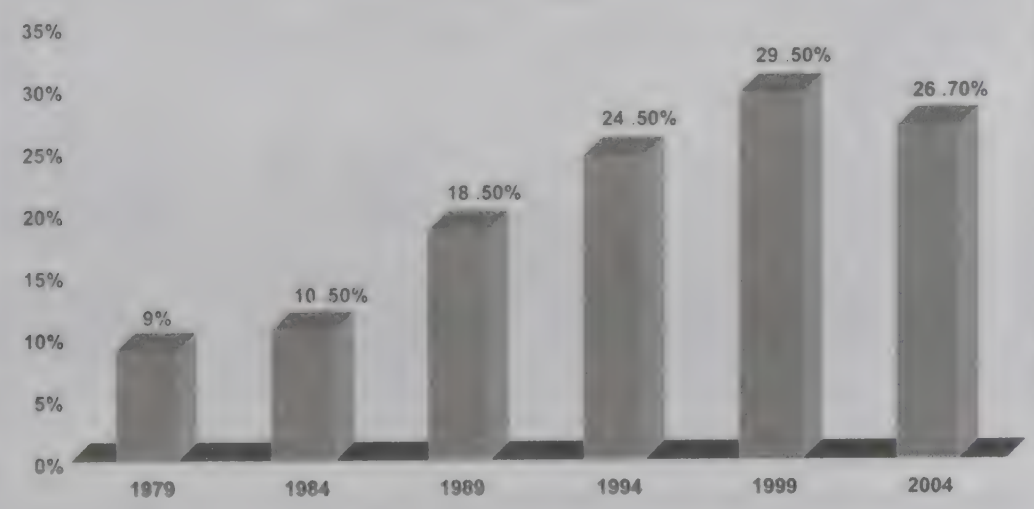


Air Pollution

- **Outdoor Air Pollution**
  - Automobile exhaust
  - Power plant emission
  - Open burning of solid waste
  - Construction related activities – dust
  - Mining activities
  - Pollen, fungi.
- **Indoor Air Pollution**
  - Aero-biologicals
  - Irritants

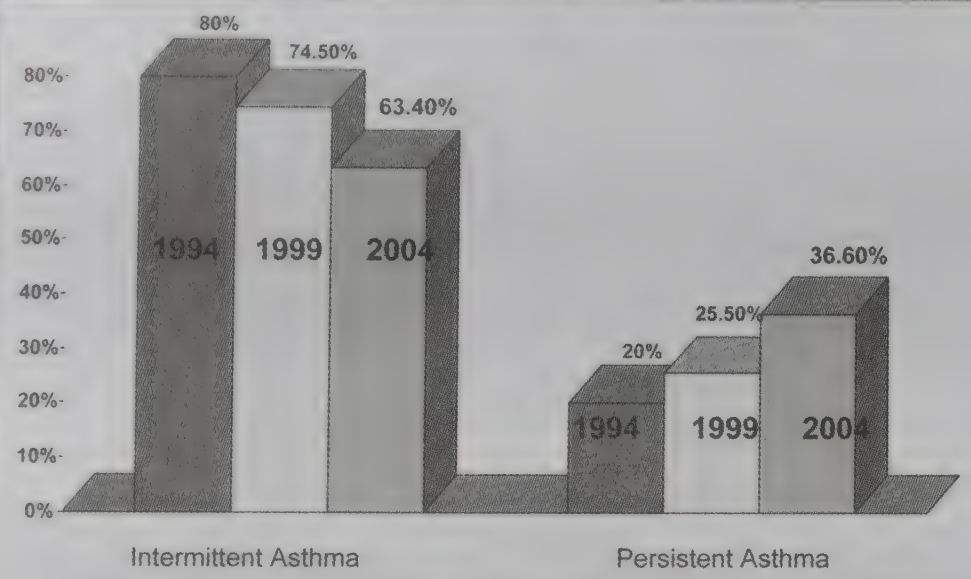
BALANCING FACTORS IN THE GENESIS OF ALLERGIC DISEASES

Trends in Asthma Prevalence 1979-2004 (P<0.05)

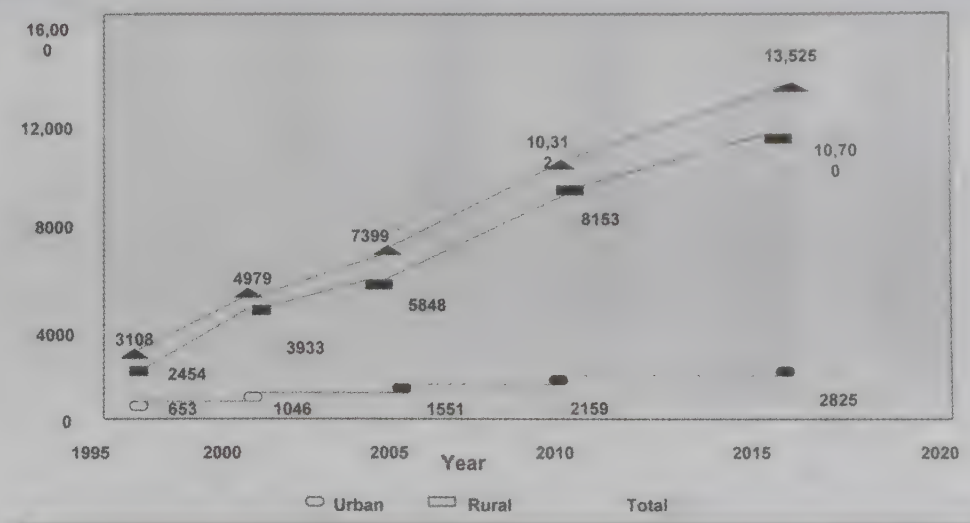


Dr H.Paramesh; Indian Journal of Pediatrics; Special Issue 2006

Prevalence of Persistent Asthma 1994 - 2004 (P<0.0058)

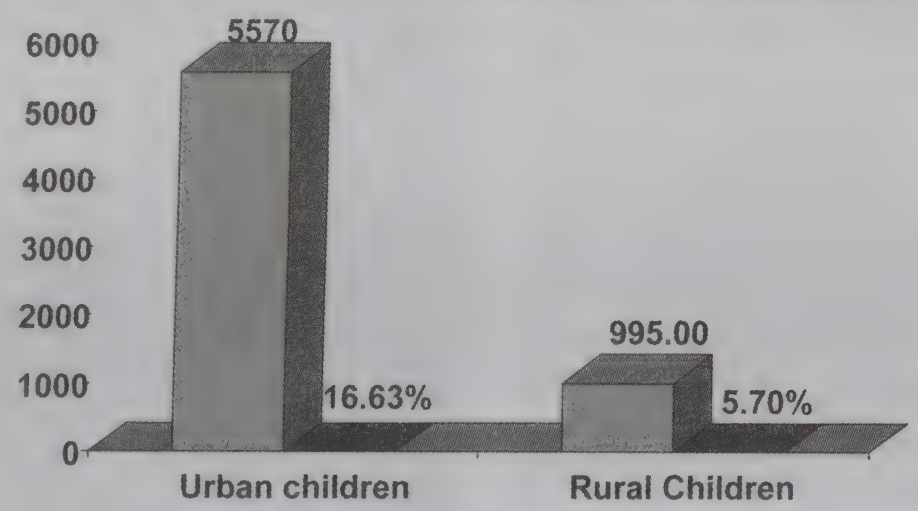


Burden on Economy from Chronic Asthma



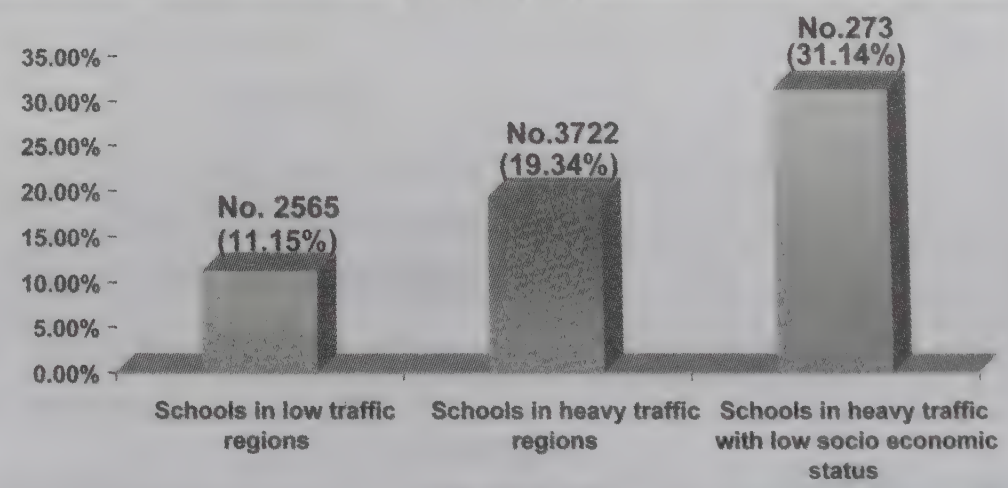
Commission on Macroeconomics and Health, Govt. of India, Sept 2005

Western Lifestyle of Living
Age 6-15 years
Urban children suffer more asthma than rural



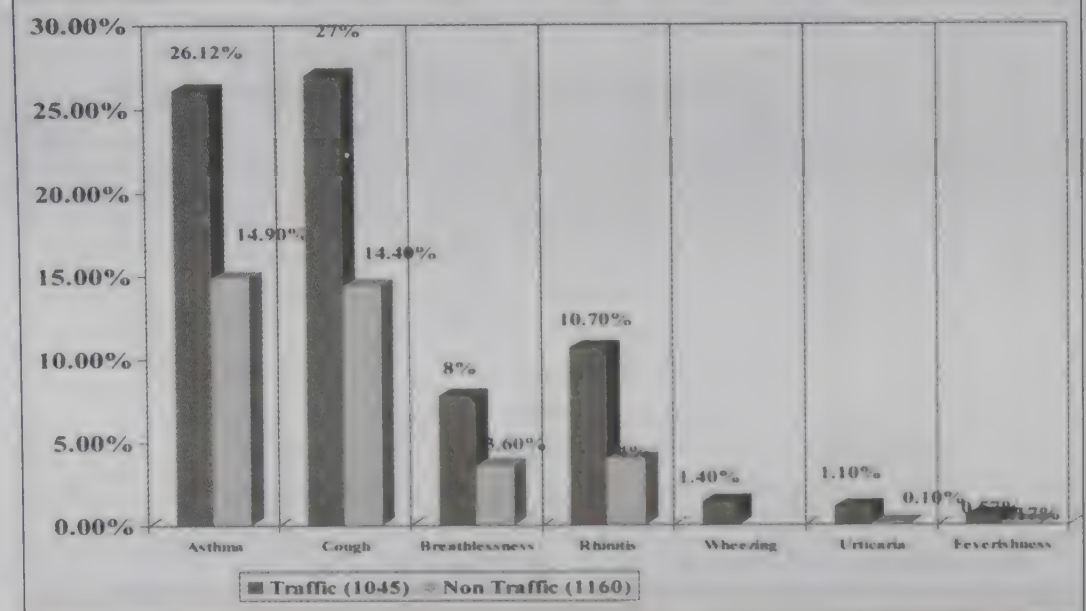
H. Paramesh. Ind. J. of Ped - 2002

Children of heavy traffic school areas suffer more from asthma
it further increases in low socioeconomic children



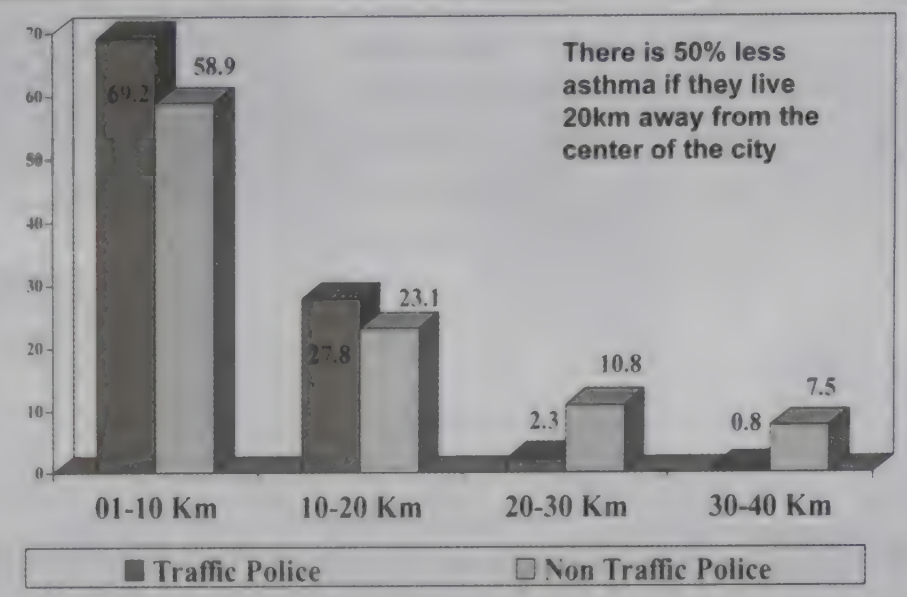
P. Value I, II & III < 0.001.
H. Paramesh, Down to earth - 2001

Traffic Police Suffer More from Air Pollution than Non-Traffic Police



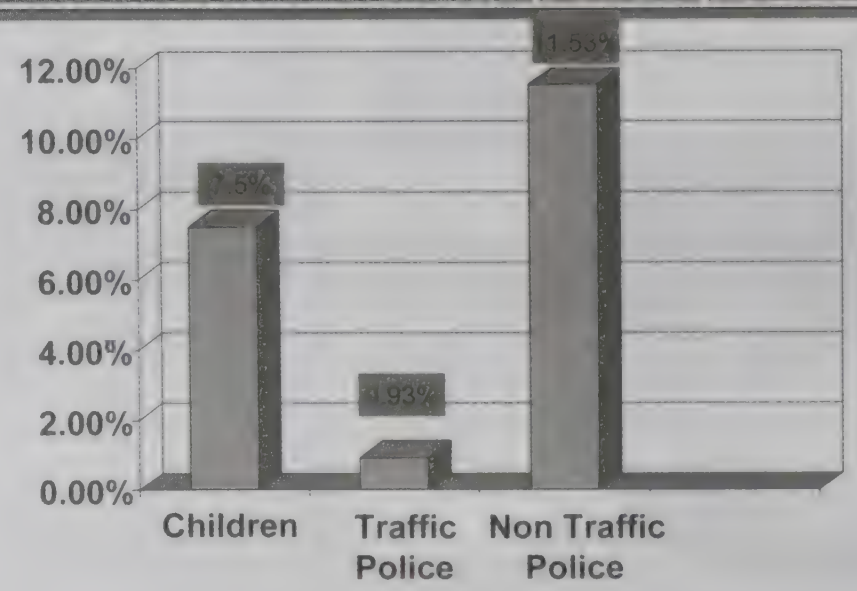
Dr. H. Paramesh, XI National Symposium on Environment, BARC, 2002

Distance of living away from the center of the city / asthma



Source - H. Paramesh, XI National Symposium on Environment 2002 BARC

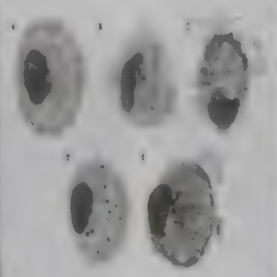
Skin Prick Test for Aeroallergens in asthmatic children and police personnel

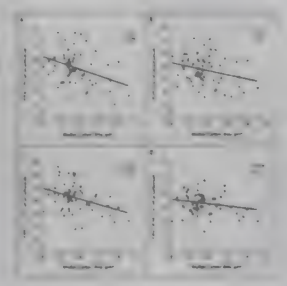


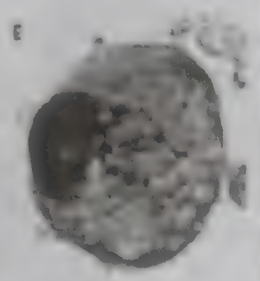
Dr. H. Paramesh

IMPACT OF PARTICULATE MATTER POLLUTION ON LUNG FUNCTION IN CHILDREN

(64 children in Leicester city, UK)







8-15 yrs old
Excluded children with chronic respiratory infection

Sputum induction for alveolar macrophages

Alveolar macrophages showing different amounts of intracellular carbon particles

Each increase of 1μm2 in carbon content in the alveolar macrophage –
17% ↓ in FEV1
12.9% ↓ in FVC
34.7% ↓ in FEF25-75%

(Kulkarni N, New Engl J Med 2006; 355: 21-30)

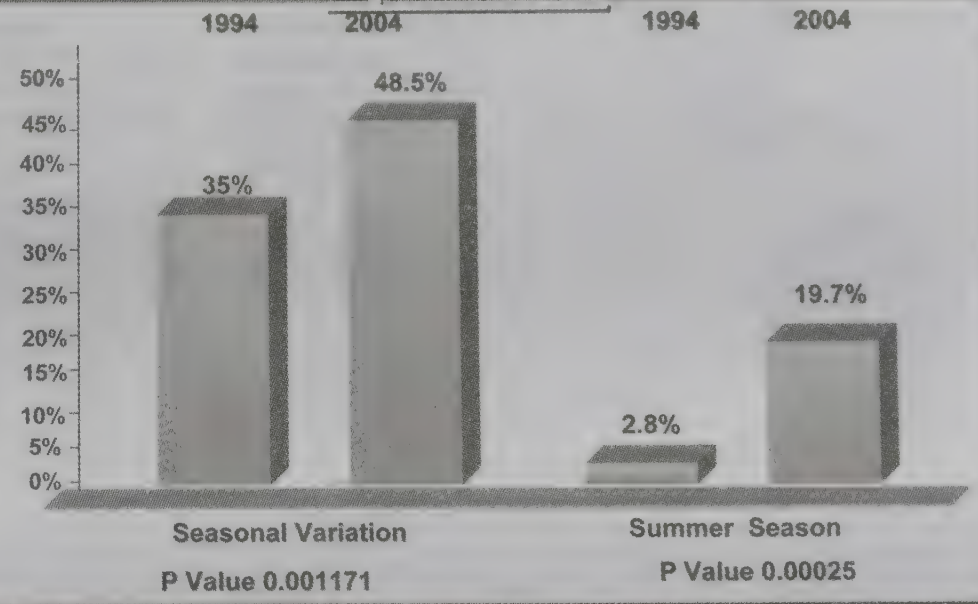
Relative emissions from Petrol Cars and Diesel Cars

Pollutant	Petrol	Diesel
Carbon dioxide	++++	+
Carbon monoxide	+++	++
Benzene	+++	++
Nitrogen oxides	+	++
Hydrocarbons	++	+++
Aldehydes	++	+++
Sulphur dioxide	+	++++
PAHs	+	++++
Particulate matter*	+	++++

- Diesel engines generate up to 1400 times more particles than petrol engines
- 10,00,00,00,00,000 particles enter into the lungs every day

Salvi.S

Seasonal Pattern of Asthma Episodes

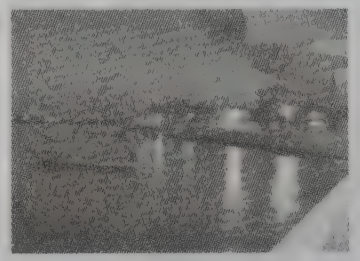


Dr. H. Paramesh, International Conference on Environment & Child Health, Vienna 2007

ENVIRONMENTAL POLLUTION

CO	**50% of all air pollutants, motor vehicles, Hypoxic ill effects. No change in PFT**
SO2	75% from fossil fuel power plant. Major component of haze. Sulphate particles constitute 10% of pm2.5 (no regular monitoring) Increases Air way inflammation, resistance, decrease ciliary activity **Increases sensitivity for asthma by 10 fold.** **50 microgram/m3 → 3% rise in total mortality**
NOX	60% from motor vehicles. Component of haze. Increases airway resistance, irritability, often permanent damage **Increases asthma by 60% and sensitivity of dust mites** **50 micro gm/m3 24hr increases asthma by 2.6%**
O3	Major component of Smog formed by NOX, VOCS and O2 in sunlight, heat. Motor vehicles major generators of NOX and VOCS Increases respiratory track irritation and infection **Increases Asthma by 43%** **50 micro gm/m3 M 8hrs increases asthma admission by 3-4%**
SPM (pm 10 & 2.5 microns)	From combustion process (more from Diesel) Direct or reflex airways spasm and carried to alveoli to other systems (Pm 2.5) • **Potentiates other pollutants, increases allergy, asthma, IgE level.**

Ultra-structural nasal pathology in children chronically and sequentially exposed to air pollutants (Calderon-Garciduenas L et al, AJRCMB 2001; 24: 132-138)



VERACRUZ CITY

MEXICO CITY

Electron microscopy of nasal mucosa

PARAMETERS	Veracruz (n = 11)	Mexico city (n = 15)
Epithelial shedding	0	14
Necrotic cells	0	12
Goblet hyperplasia	0	4
Patchy absent cilia	0	15
Squamous metaplasia	0	8
Intraepithelial PMN	2	15
Intraepithelial monocyte	0	3
Particulate matter in intercellular spaces	0	5

Calderon-Garciduenas L et al, AJRCMB 2001; 24: 132-13

Indoor Pollutants

Aero-biologicals

- Dust mite - 4000/g
- Cockroach - 25.00%
- Fungi Pollens - 07.50%
- Pets - 05.00%
- Viruses/Bacteria - 40.00%
  - RSV
  - Para influenza
  - Corono
  - Adeno
  - Legionella
- Food - 19.90%

Irritants

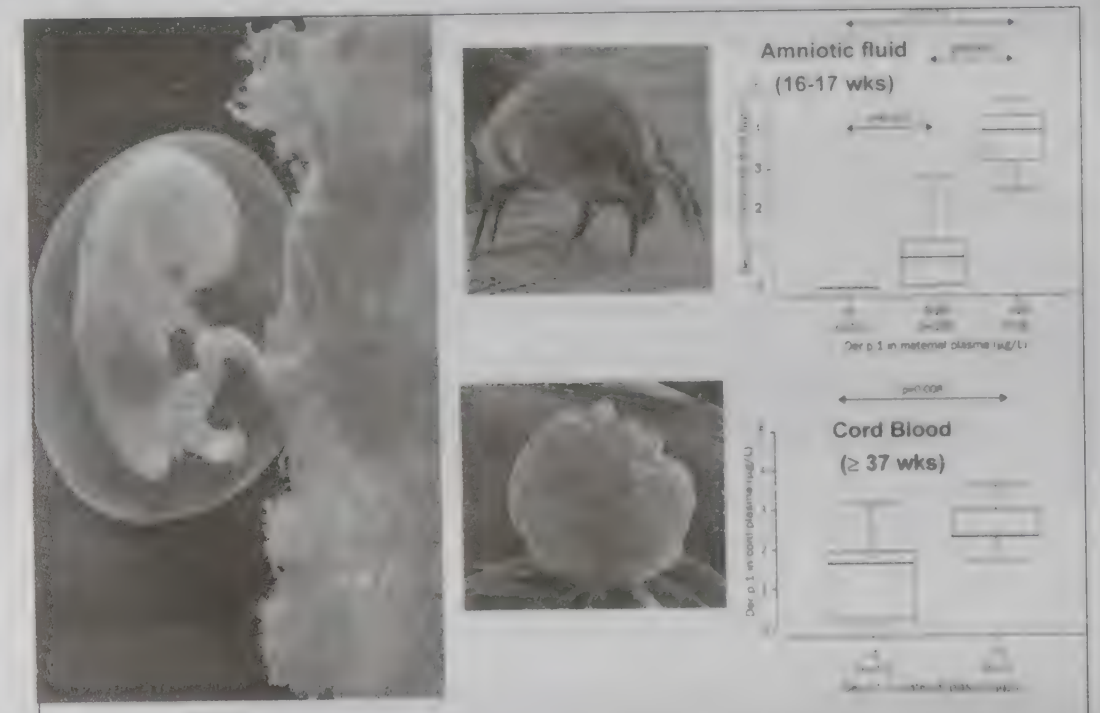
- Cigarette smoke
  - 1994 - 6.0%
  - 1999 - 7.5%
  - 2004 - 7.9%
- Mosquito Coil - 5.0%
- Other smokes
- Formaldehyde
- Volatile organic compounds
- Asbestos
- Radon

H. Paramesh Ind. Jourl. of pediatrics - 2002

Women and Children Bear the Brunt of Indoor Air Pollution

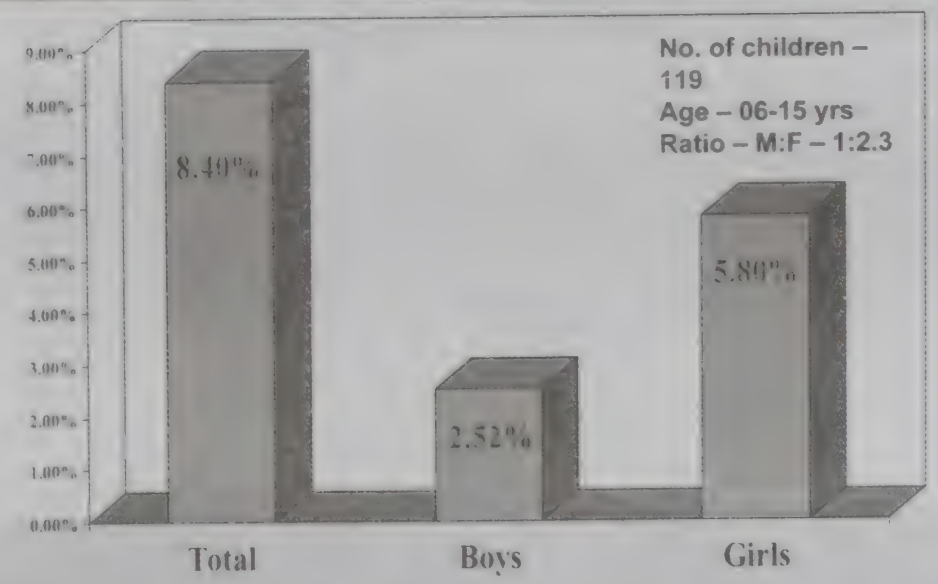
Those Living in Slums are the Worst Affected

Mean exposure to respirable particulate matter
Courtesy: Teri, Green India – 2047; 2003



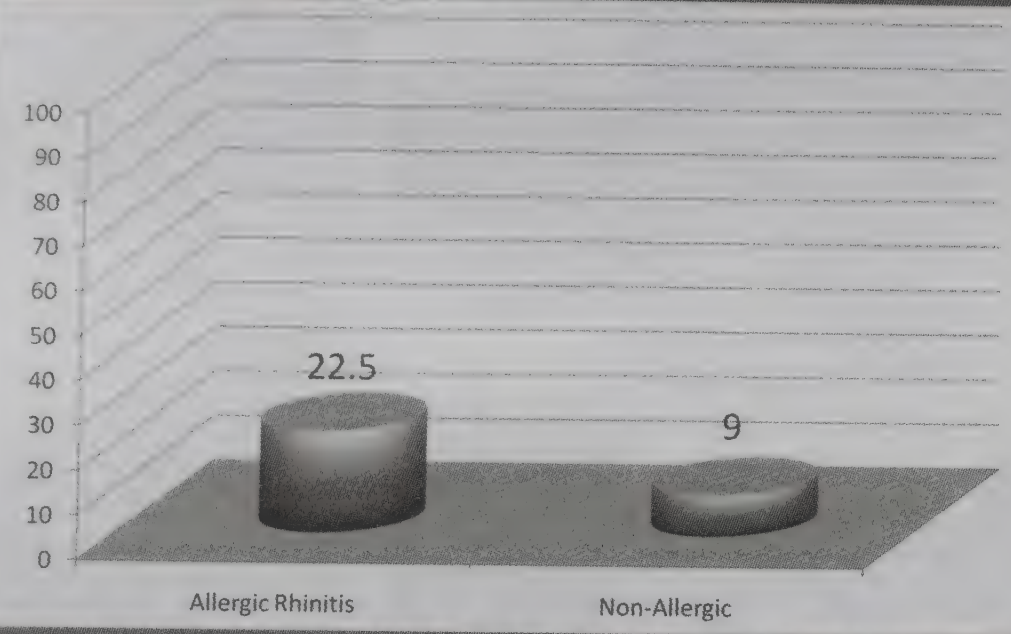
(Holloway J et al, Lancet 2000; 356: 1900-1902)

Indoor Air Pollution: Gender Change in Asthma Prevalence



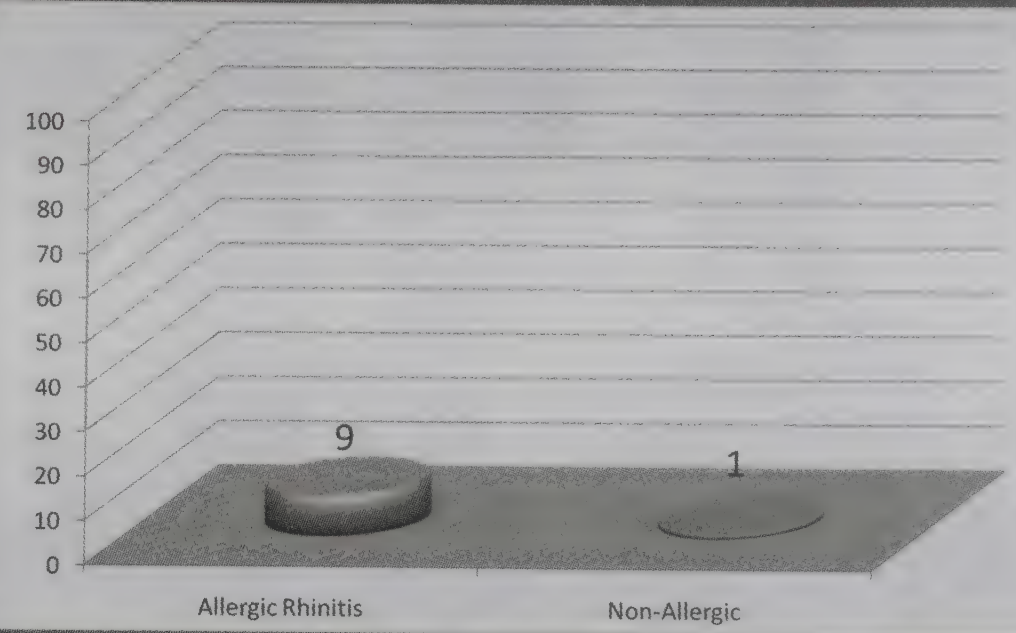
Source - H. Paramesh, E. Cherian. Ind. Joul of Pediatr 2002

Otitis Media



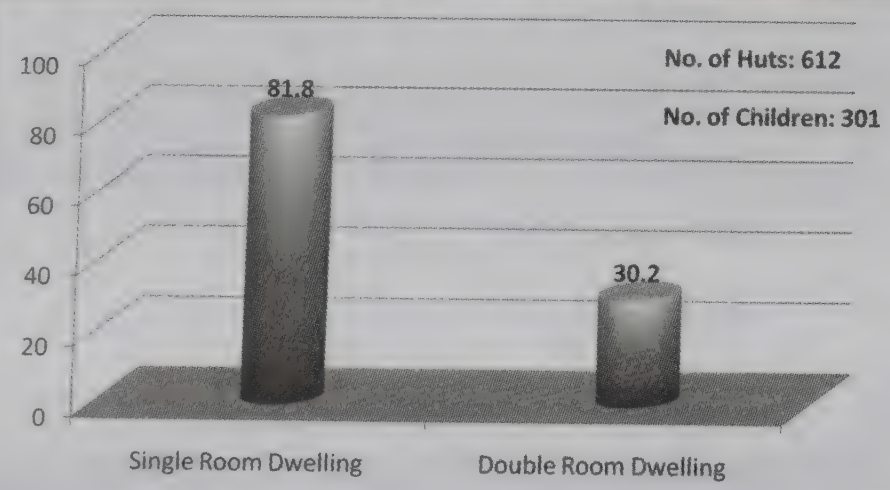
Dr. H. Paramesh, IAP Text Book of Pediatrics 2002

Sinusitis



Dr. H. Paramesh, IAP Text Book of Pediatrics 2002

Point Prevalence of Respiratory Infection/Indoor Air Pollution in Children Under 5 yrs. A Rural Study



Children living in single room are 10.5 times more likely to develop respiratory infection when compared to children living in double rooms. P<0.001**

Elizabeth Cherian, H. Paramesh

Lead Poisoning

- Ingested, inhaled or absorbed through skin
- **Source**
  - **86% of atmospheric lead – auto exhaust, leaded petrol**, water pipes, paint, battery storage, crystal glass, ceramic glaze, enamel, jewelry, etc.
  - Lead concentration in dust is directly proportional to the volume of traffic.
  - Children absorb 50% and adults 10-20% of ingested lead.
  - Lead in tissue, cord blood correlate with air levels.
- **Effect**
  - GIT, peripheral nerve, central nervous system
  - **Saudi Arabic study – 5000 children – 1989 – using 0.8G/L of lead in petrol showed no alarming lead poisoning levels.**
  - **Bangalore study – 863 children – using 0.59 G/L of lead in petrol showed – 4.6% of increased lead level over 10 μg/dl***
- **Trend**
  - Use of unleaded petrol will reduce lead pollution. No cause for fear psychosis, however there should not be any complacency in preventive measures. **Avoid media-genic disease**.

* H. Paramesh, Sameera,Taipae, Taiwan – 2000

Remedial Measures to Control Asthma

- Control outdoor pollution
- Control of environment tobacco smoke
- Clean fuels for cooking
- Improve the ventilation of houses
- Avoiding over crowded house, classes
- Good maintenance of houses
- Construction of houses to our needs and interior decoration to suit our atmosphere
- Prolonged breast feeding of children atleast until 6 months
- Start solids after 6 months
- Sun dry the beddings, blankets, pillows once a week
- Use indoor plants and expose to sunlight once a week
- Control cockroach menace
- Better garbage disposal
- Traditional food habits.

Dr. H. Paramesh

The Impact of Our Research Work

- Utilized by **Supreme Court of India:**
  - In appointing Bhurelal Committee to clean up the cities in a time – bound fashion.
  - Instructions to builders to follow strict guidelines at school environment.
- Police personnel study **discussed in the Parliament** for remedial measures of the air pollution.
- Bringing **legislation to ban tobacco smoke in public places in Karnataka**
- Our references have been cited internationally .
- Instituted **lung functions, pulse oximetry and audiometry** to all the employees and public who have been affected by all industries.
- Instituted measurement of **ozone, ultra-fine particles (2.5 microns) and sulphate** particles by Bangalore Metro Rail system.

Dr. H. Paramesh

"Shape the Future of Life: Healthy Environment for Children"

The Children of today are the adults of tomorrow. They deserve to inherit a safer, fairer and healthier world.
There is no task important than safeguarding their **"ENVIRONMENT".**
Let us air our concern to policy makers for better future.

Community health and Air pollution: Community action to reduce environmental health risks

January 22-23,Bangalore

Workshop on Environmental health:
Intervention programmes for mitigating
air pollution-related health risks

Dr.R.Sukanya
Community Health Cell
Bangalore

Air pollution and health impact

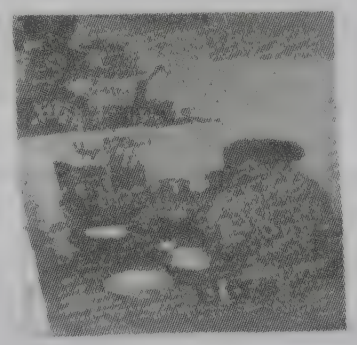
- Clean AIR is being lost-the most precious natural resource for survival of living beings
- Disease burden – Disease,Disability,Death
- Respiratory infections,Lung cancer,Chronic obstructive respiratory disease,reactive airway disease-asthma- MAJOR health problems
- Low birth weight, Congenital anomalies,Cardiovascular disease,other cancers

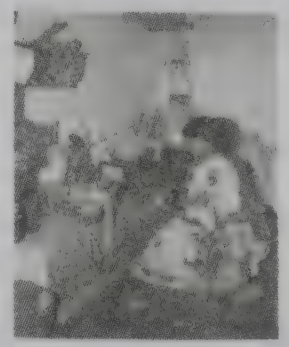
Community health impact

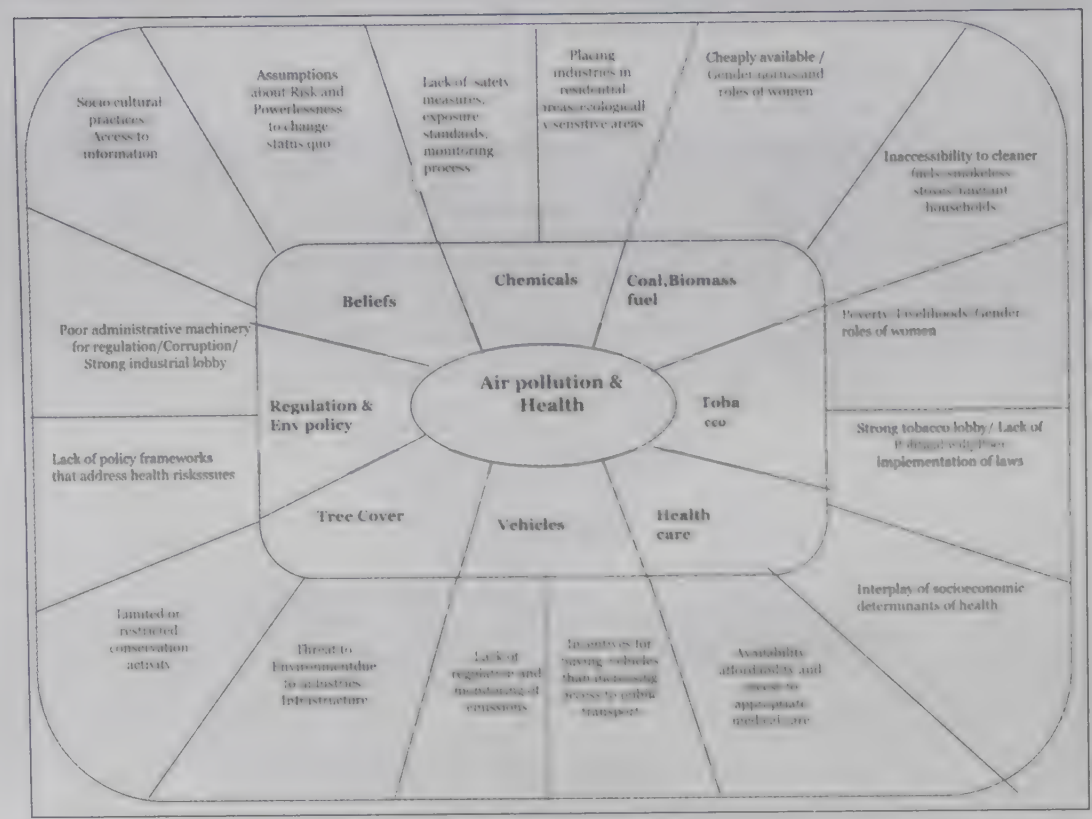
- Disability adjusted life years lost due to Indoor air pollution 5 fold the disease burden due to outdoor air pollution
- Workplace exposures (outdoor and indoor) and disease burden –12% of COPD disease
- Outdoor pollution interacts with other forms of pollution and increases vulnerability
- Tobacco smoke – single important risk factor

DISPROPORTIONATE BURDEN OF DISEASE

WOMEN AND CHILDREN – MOST VULNERABLE







What have we done?

- Air quality monitoring – KSPCB
- TASK FORCE ON AIR QUALITY
- Attempts of civil society – government partnership in infrastructure development or maintenance of green spaces
- Health risk assessment of Air pollution-ROHC
- Implementation of cleaner fuels
- Consortium for tobacco free Karnataka

Consortium for tobacco free Karnataka (CFTFK)

- CFTFK is a network of organizations working towards tobacco control in the state,initiated by CHC
- Children, office goers,health professionals, patients and their relatives,general public
- Create awareness about ill effects of tobacco, socioeconomic political aspects of tobacco cultivation and the industry
- Policy work on ban of tobacco
- Networking with community groups

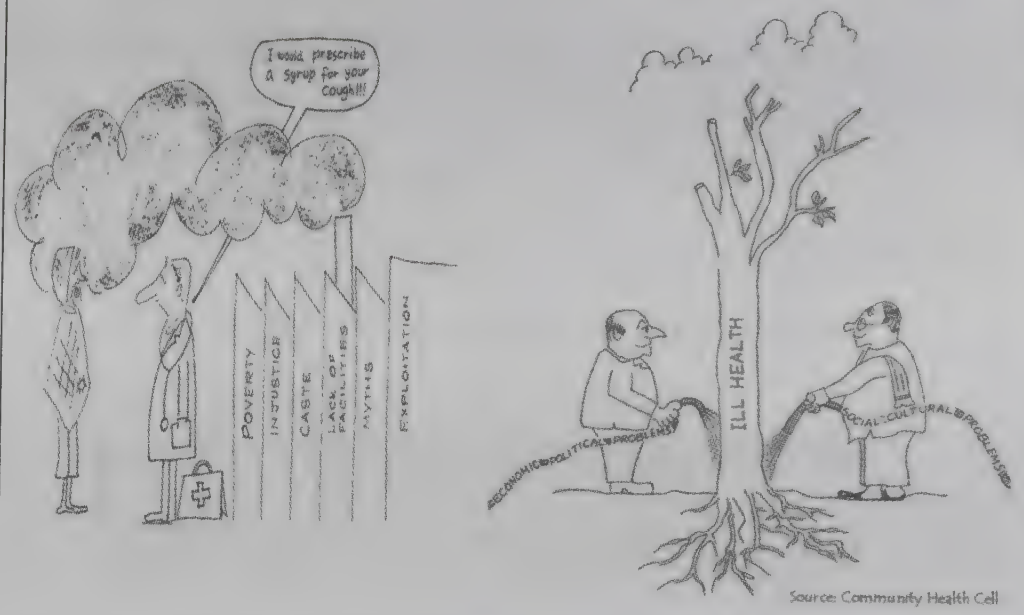
What do we need to do ?

- Complex factors – multiple level of interventions
- Interventions have to be equitable
- Public participation for Community Action
- Access information
- Community health – absence of disease, economic productivity, social well being-educational attainment

Challenges – Community Action

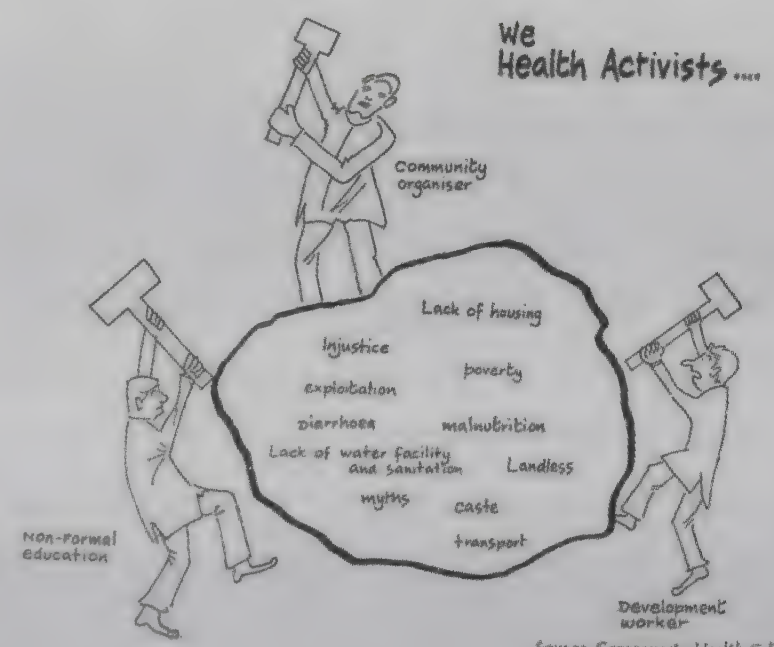
- Human perception of risk determines response to health risk
- Communities become risk bearers
- Polluting Technology- Has to be eliminated
- Convergence of different communities and varied resource groups
- Framework of Equity

Challenges –Community Action



Source: Community Health Cell

We need to do



Source: Community Health Cell

Advantages - Community action

- Preventing Disease - ↓ Health care costs
  ↓ Disease burden
- Long term impact on Health
- Most equitable option – benefits across broad groups or populations

Ambient Air Pollution in Bengalooru

B. Nagappa and Dr. H.C. Sharatchandra
KSPCB, Bangalore

NAAQ Standards

- AAQS are pre-requisite for developing programme for effective management of AAQ and to reduce the damaging effects of air pollution
- Objectives of air quality standards are to
  - Indicate the levels of air quality necessary with an adequate margin of safety to protect the public health, vegetation and property.
  - Assist in establishing priorities for abatement and control of pollutant level.
  - Provide uniform yardstick for assessing air quality at national level
  - Indicate the need and extent of monitoring programme
- CPCB notified the first AAQS on 11-11-1982 and Revised it on 11-4-1994
- National Ambient Air Quality is notified for
  - 6 Pollutants viz. SO2, NO2, SPM, RSPM, Pb, CO, NH3
  - 3 types of areas viz. Industrial, Residential, Rural & other Area, Sensitive Area

AAQM by KSPCB

- KSPCB is monitoring AAQ in Bangalore from 1984

Initially at 3 Stations

- **Ananda Rao Circle – Traffic Junction**
- **Graphite India – Industrial Area**
- **Amco Batteries – Industrial and Mixed**

During 2004-05 , additional 3 station installed

- **Victoria Hospital – Sensitive area**
  (Shifted from ARC. due to construction of flyover)
- **Yeshavanthpur Police station - Traffic Junction]**
- **Peenya Ind. Area -Industrial Area**
- **K.H.B Indu Area-Industrial Area**

Pollutants : **SO_2, NOx, RSPM and SPM**

Source of Air pollutants

Point source

Includes:- Industrial and non industrial stationary process, major industries, boilers, wood and pulp processors, refinery, chemical processing operations and petroleum storage tanks:

Stack Monitoring

Non-Point source

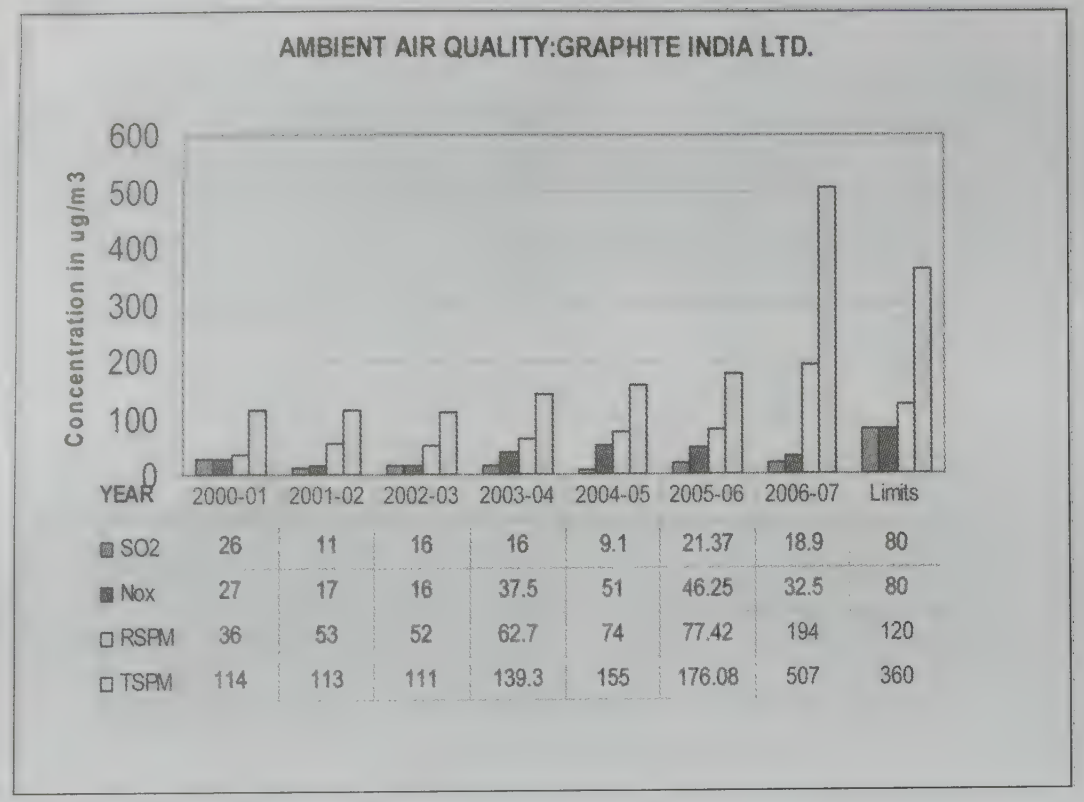
Area source

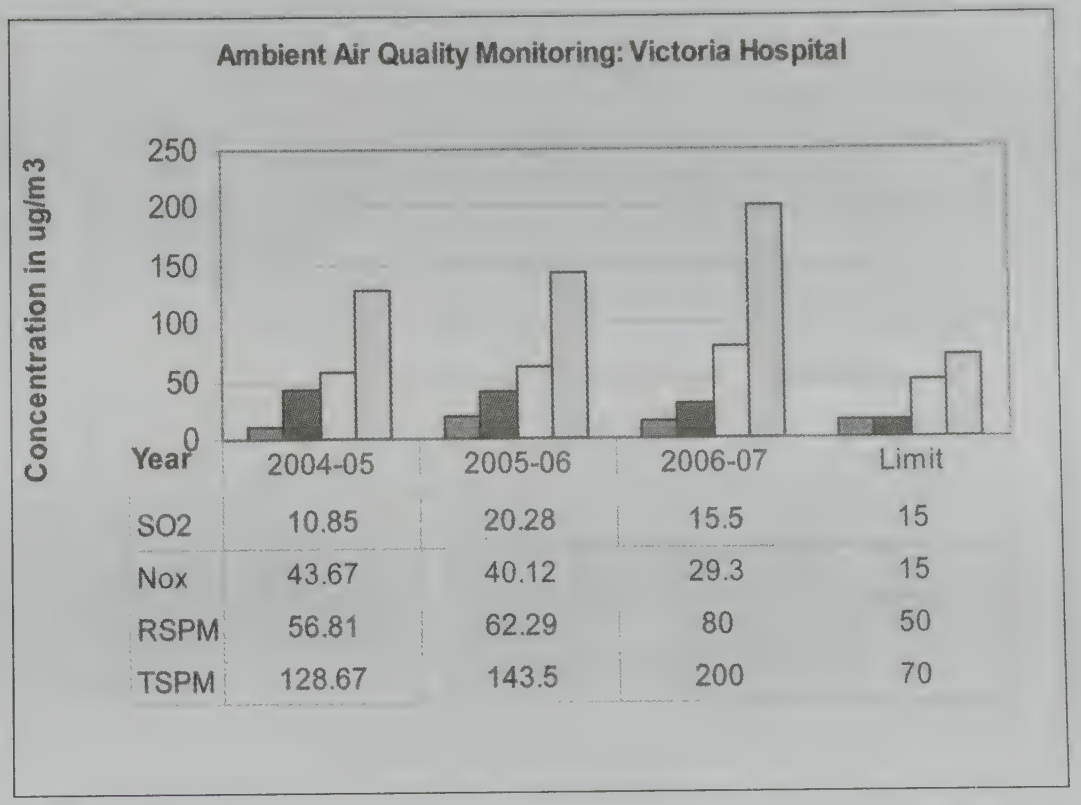
Residential fuel combustion, construction activities, mining and quarrying , crop burning, waste management (landfill), Product storage and distribution (gasoline), forest fires, unpaved roads:
Manual AAQM/CAAQM

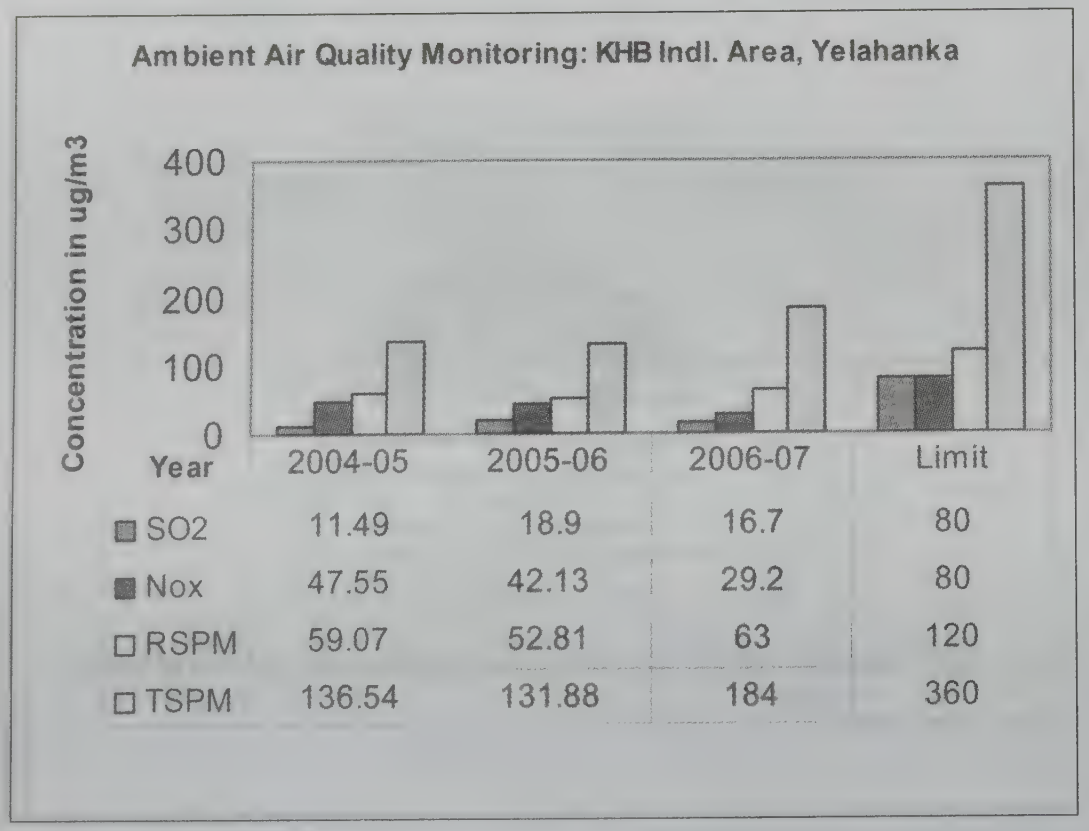
Non-road mobile source: Small engine vehicles used in lawn, garden, Agricultural logging, road/industrial construction vehicles
Manual AAQM/ CAAQM

Biogenic sources : Emission of natural sources termed as biogenic sources.
Ex. damaged vegetation:- Gas Analyzers

On-road mobile source: Light and heavy duty petrol and diesel vehicles: Vehicular pollution monitored by RTO as per MVAct







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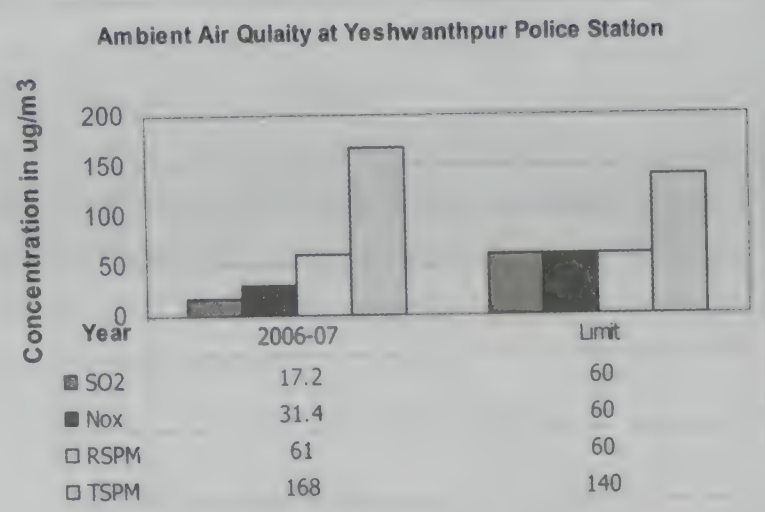
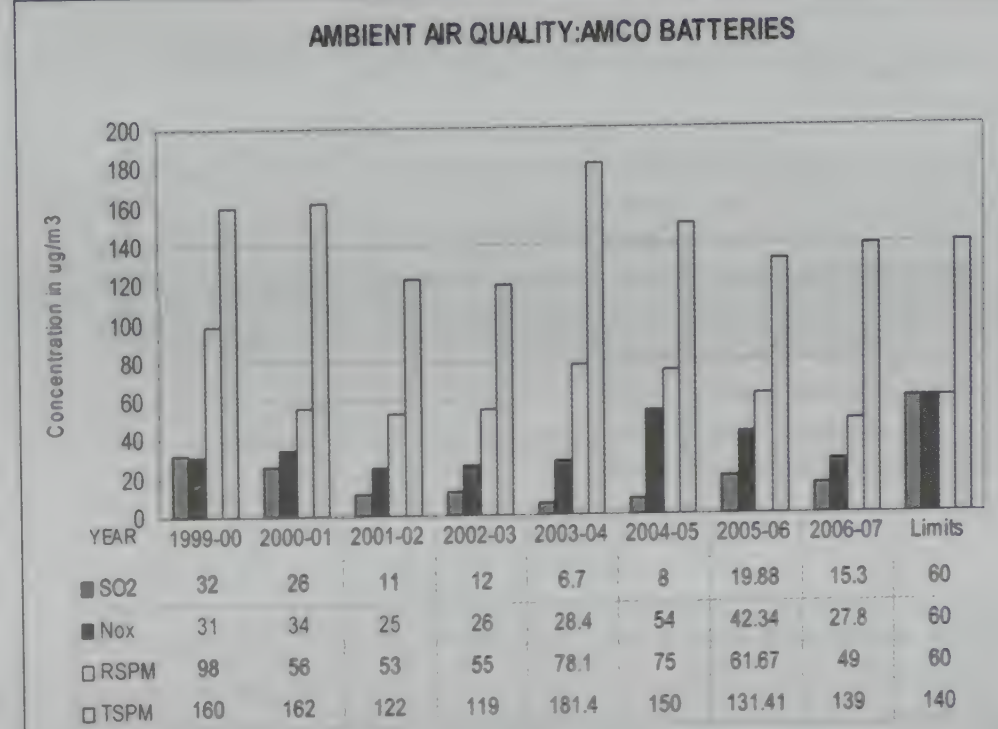
- Community health – absence of disease, economic productivity, social well being-educational attainment





Concentration in Ambient Air		SO_2 µg/m³		NO_2 µg/m³		RSPM µg/m³		SPM µg/m³	
		Std	Anl Avg (06-07)	Std	Anl Avg (06-07)	Std	Anl Avg (06-07)	Std	Anl Avg (06-07)
Graphite India	Industrial Area	80	18.9	80	33.5	120	194	360	507
Peenya	Industrial Area	80	15.5	80	27.7	120	78	360	278
KHB. Indu, Area, Yalahanka	Industrial Area	80	16.7	80	29.2	120	63	360	184
Yashavant hpur	MixedUr ban Area	60	17.2	60	31.4	60	61	140	168
Amco Batteries	MixedUr ban Area	60	15.3	60	27.8	60	49	140	139
Victoria Hospital	Sensitive Area	15	15.5	15	29.3	50	80	70	200

Air Quality Standards

Pollutant	Time Weighted average	Concentration in Ambient air		
		Industrial Area	Residential, Rural & other areas	Sensitive Area
Sulphur Dioxide (SO_2)	Annual Average* 24 hours**	80 µg/m³ 120 µg/m³	60 µg/m³ 80 µg/m³	15 µg/m³ 30 µg/m³
Oxides of Nitrogen as NO_2	Annual Average* 24 hours**	80 µg/m³ 120 µg/m³	60 µg/m³ 80 µg/m³	15 µg/m³ 30 µg/m³
Suspended Particulate Matter (SPM)	Annual Average * 24 hours**	360 µg/m³ 500 µg/m³	140 µg/m³ 200 µg/m³	70 µg/m³ 100 µg/m³
Respirable Particulate matter (RPM) (size less than 10 micron)	Annual Average* 24 hours**	120 µg/m³ 150 µg/m³	60 µg/m³ 100 µg/m³	50 µg/m³ 75 µg/m³
Lead (Pb)	Annual Average* 24 hours**	1.0 µg/m³ 1.5 µg/m³	0.75 µg/m³ 1.00 µg/m³	0.50 µg/m³ 0.75 µg/m³
Carbon Monoxide (CO)	8 hours** 1 hour	5.0 mg/m³ 10.0 mg/m³	2.0 mg/m³ 4.0 mg/m³	1.0 mg/m³ 2.0 mg/m³

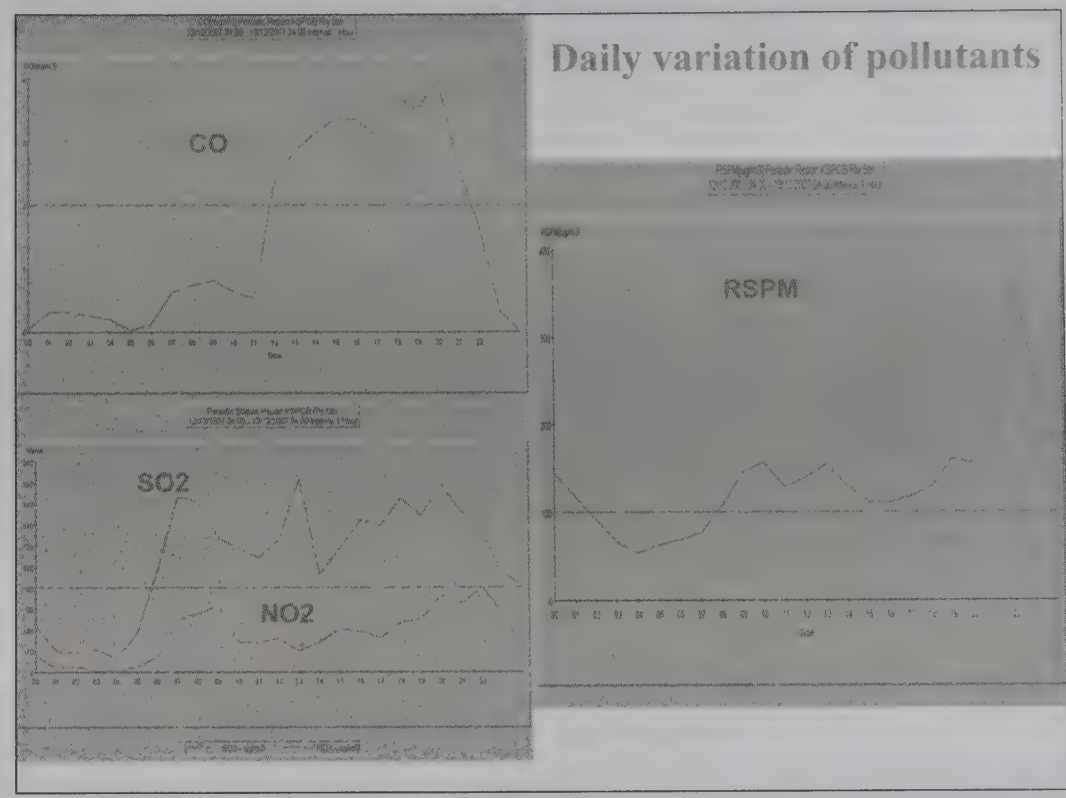
1. Annual Arithmatic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.
2. 24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

CAAQMS at S.G.Halli and City Railway station

Pollutants Monitored : SO_2, NO_X, CO and RSPM

Weather monitoring –wind speed & direction, ambient temp, humidity and solar radiation

Daily variation of pollutants



Future plans of KSPCB

1. To add 7 more manual monitoring stations) (GOK has sanctioned Rs 15 Lakhs)
2. To monitor $PM_{2.5}$ particulate matter at Traffic intersections , (CPCB has sanctioned Rs 20 Lakhs)
3. Characterization of $PM_{2.5}$ particulate matter for metals, anions and cations, CO, organics like Aldehydes, HCs, PAHs VOCs (Benzene, toluene and xylene).

Conclusion

- Annual average concentrations of SO_2, NOx, RSPM and SPM at Victoria Hospital (Sensitive area) have exceeded the NAAQS. There is a continuous increasing trend over the years
- Annual average concentrations of SPM at Graphite India (Industrial Area) has exceeded the NAAQS. Continuous increasing trend over the years. SO2,and NOx have not exceeded the NAAQS, but there is marginal increase over the years
- Annual average concentrations of SO_2, NOx, RSPM and SPM at PIA, Yeshwanthpur, KHB and AMCO batteries (Mixed urban Area) have not exceeded the NAAQS .There is a continuous increasing trend over the years
- CAAQMS: hourly variation of gaseous pollutants indicates that from 5.AM to 8 PM the levels have exceeded the NAAQS.
- RSPM varied from 4 AM to 10PM and exceeded the NAAQS. There is continuous increase in the day and decrease in night

Indoor air pollution (IAP) and its management

Workshop on Environmental Health
Organised by KSPCB and Cerana Foundation
22nd and 23rd Jan 2008, Bangalore.

Presented by Ms Dhenuka Srinivasan,
Associate Fellow, TERI

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Overview of the presentation

- What is IAP in built environments
- Importance of IAP
- Common indoor air pollutants, sources and health effects
- Monitoring and management
- TERI's experience in IAP monitoring

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IAP in commercial buildings

- IAP in built environments are different from IAP in poor/ rural households that are essentially from the use of biomass/ low grade fuels for cooking.
- Limited studies exists in developing countries like India
- Scenario is very different from IAP problems in developed countries.
- Indoor levels of pollutants may be **2-5 times** higher than outdoor levels.
- These are of particular concern because most people spend about **90%** of their time indoor

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IAP in commercial buildings contd.

- Air- tight buildings cause accumulation of indoor pollutants generated within
- Air conditioning, ventilation systems and maintenance of buildings have their impacts on IAP
- Lack of ventilation combined with pollutants levels may lead to sick building syndrome (SBS)
- In SBS building occupants experience acute health comfort effects that appear to be linked to the time spent in a building

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Sick building syndrome (SBS)

- SBS is a combination of ailments (a syndrome) associated with an individual's place of work or residence.
- A WHO report into the syndrome suggested up to 30% of new and remodelled buildings worldwide may be linked to symptoms of SBS.
- Most of the sick building syndrome is related to poor indoor air quality.

SBS contd...

- **Sick building causes are frequently pinned down to flaws in the heating, ventilation and air conditioning (HVAC) systems.**
- **Other causes have been attributed to contaminants produced by out-gassing of some types of building materials, volatile organic compounds moulds**

Common indoor air pollutants

- Sulphur dioxide
- Nitrogen dioxide
- Carbon monoxide
- Particulates (TSP, RSP)
- Formaldehyde
- Radon
- Ozone
- lead
- Asbestos
- Bio aerosols

Pollutant	Source
SO_2	Combustion source, environmental tobacco smoke and infiltration from outdoors
NO_2	Combustion source, environmental tobacco smoke and infiltration from outdoors
CO	Combustion source, environmental tobacco smoke and infiltration from outdoors
Particulates	Combustion source, environmental tobacco smoke and infiltration from outdoors
HCHO	Woods products, wall paneling, particle boards, urea-formaldehyde foam insulation
Radon (radioactive)	Building materials, natural rock and minerals
O_3	Photocopiers and laser printers
Pb	Paints
Asbestos	Building material
Biological organisms/moulds/bioaerosols	Food, moisture/water stagnation/ carpets etc.

Common indoor pollutants

Based on the health problems caused IAP pollutants can be grouped primarily as pollutants from:

- Combustion sources (SO_2, NO_2, CO, particulates)
- Environmental tobacco smoke
- Volatile organic compounds (formaldehyde, pesticides, solvents and cleaning agents)

Bio allergens

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Health symptoms of pollutants from Environmental tobacco smoke

- Rhintis, pharyngitis, nasal congestion, persistent cough, conjunctival irritation
- Headache
- Wheezing
- Exacerbation of chronic respiratory conditions
- Asthma
- Frequent respiratory infections
- Pneumonia, bronchitis

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Health symptoms of pollutants from combustion sources

- Dizziness or headache
- Confusion
- Nausea
- Fatigue
- Eye and upper respiratory tract irritation
- Wheezing/ bronchial constriction
- Persistent cough
- Elevated blood carboxyhemoglobin levels
- Increased frequency of angina in persons with coronary heart disease

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Health symptoms of volatile organic compounds

- Conjunctival irritation
- Nose, throat discomfort
- Headache
- Allergic skin reaction
- Dypnea
- Nausea
- Epitaxis (mainly from HCHO)
- Fatigue
- dizziness

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Bio allergens

- Biological contaminants include bacteria, molds, mildew, viruses, animal dander and cat saliva, house dust mites, cockroaches, and pollen.
- By controlling the relative humidity level in a built environment, the growth of some sources of bio allergens can be minimized.
- Some bio allergens are known to trigger allergic reactions, including hypersensitivity pneumonitis, allergic rhinitis, and some types of asthma.

Pro-active monitoring and management

- Pro-active monitoring and management of air quality reduces the risk of *"healthy"* building from turning into *"sick"* buildings
- Improves overall maintenance and operations
- Provides a safe and healthy environment for employees

Basic IAP monitoring steps

- Initial walk-through of the building area
- Interviews/ questionnaires survey of the occupants
- Detail monitoring and analysis of key IAP pollutants
- Adoption of mitigation measures

Various standards	Key indoor pollutants						
	SPM µg/m³	RSPM µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO_2 ppm	CO ppm	HCHO ppm
ASHRAE standard	150	-	100	365	1000		0.4
CPCB standard (24 hours)	200	100	80	80	-	1.75*	-
WHO guidelines	40 - 60	-	100 to 150	150	-	8.8*	-

* Standard for 8 hours

TERI's experience

- Has conducted a number of IAP studies in commercial facilities.
- Past studies point out high indoor particulates levels
- This is essentially associated with outdoor air infiltration
- Ventilation and occupancy rates are important parameters
- Need for regular maintenance and repairs of air handling systems

Effective IAP mitigation programme

- Regular monitoring of key pollutants
- Frequent inspection and maintenance of office buildings
- Maintaining strict ventilation and occupancy standards
- Maintaining the right temperature and humidity levels
- Educate employees of some of the common IAP problems and associated health effects
- Establish effective system of logging and responding to complaints from employees
- Continuous action on feed back and complaints obtained from the employees

To Sum up.....

- Currently very limited studies exists on IAP inbulit environments.
- Though many built environments may face this problem.
- Currently no standards in the country.
- Need more awareness to facility managers and public at large.
- Regular monitoring and maintenance of facilities required.

For further details contact:
Ms. Dhenuka Srinivasan
Associate Fellow,
Centre for Resources and the Environment,
The Energy and Resources Institute (TERI)
Email: **dhenuka@teri.res.in**

Discussion:

Q Outdoor air pollution leads to a build up of indoor air pollution (IAP). No filters can eliminate SO_x, NO_x. A large number of schools are located on busy roads, how can the matter be addressed?

A *In order to curb ambient air pollution*

- *Awareness may be created about the possible sources of pollutants.*
- *Architects and managers must aim at elimination of IAP*
- *Efforts must be made at micro levels*
- *Outdoor air pollution (OAP) should be dealt with through stringent policies.*
- *Traffic should be minimised as per the SC order*
- *Air space and lung space should be provided*

Q Have the relative roles of wood, coal, LPG fuels in creating pollution been studied?

A *IAP in rural areas is due to use of low grade fuels. Polluting emissions are known to decrease with each climb of the energy ladder. Low grade solid fuels emit and pollute more than liquid fuel which in turn pollutes more than gaseous fuel does.*

According to the World Health Organisation (WHO) estimates women are three times more at risk of developing respiratory disorders.

Cleaner fuels lead to less emission which improves air quality.

Roughly the energy ladder may be depicted as such:

Electricity (better than) LPG (better than) Coal (better than) Wood (better than) Cow dung.

Not enough energy to meet all needs is available.

Atomic energy should be considered as an alternative as it is one of the cleanest fuels. Thorium available in India is sufficient and we need not be uranium dependent.

Q Increase in NO_x concentration leads to cancer i.e. increase in white blood corpuscles (WBC) or red blood corpuscles (RBC). How can it be reduced?

A *NO_x concentration has exceeded the national standards. To reduce NOx concentration in many urban areas, catalytic converters should be used. Introduction of lead free petrol has helped reduce lead emissions.*

Q How should batteries be disposed?

A *A few voluntary initiatives exist for battery disposal but more are required.*

Q Is any data available on the loss of tree cover and the impact such loss has on health?

A *No such data exists. However it is a fact that the air quality in Bangalore has decreased due to the decrease in tree cover. In 1983 there was 53% green cover and by 2005 it had reduced to 32%. There is need to create awareness amongst the public about this.*

Q It is reasonable to feel concerned at the lack of implementation despite innumerable workshops. While one must avoid alarming the public how else may one put facts out in the open?

A *When policy makers fail to do their work a responsible media must project proper information without unduly creating panic. Finally the public must decide what they want. For instance the petrochemical industry emits chlorinated hydrocarbons which are carcinogenic. The public must decide whether they want plastic goods or they want safer substitutes.*

Plenary Session 2:
Current responses and challenges to air pollution related health risks

Chair: Dr R Mahesh Babu
Consulting physician

Environmental care Critical Concern

Presentation by – Mr. Anand Rao KSRTC & BMTC

Traffic Planning for better Air Quality

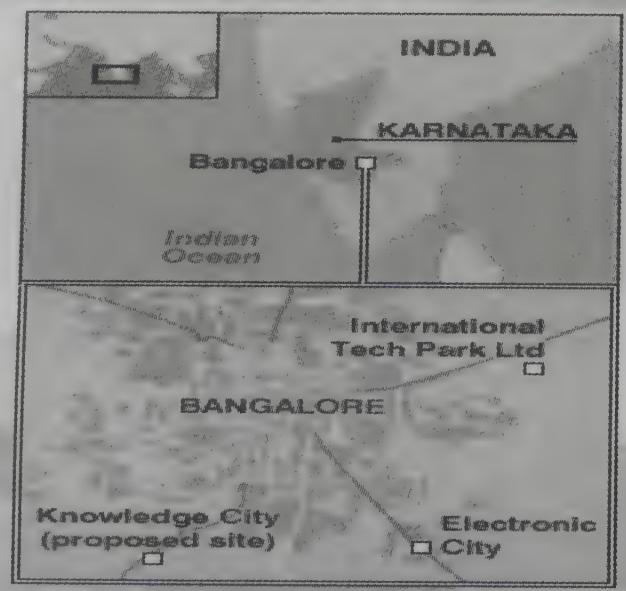
Karnataka State Road Transport Corporation

Environmental care Critical Concern

Bangalore is the capital of the Indian state of Karnataka. Located on the Mysore Plateau in southwestern Karnataka, Bangalore has an estimated metropolitan population of 6.1 million (2006), making it India's third-largest city and fifth-largest metropolitan area. Late. Kempe Gowda, the architect of modern Bangalore, built a mud fort in the city and established it as a province of the Vijayanagara Empire.

Karnataka State Road Transport Corporation

Environmental care Critical Concern



Karnataka State Road Transport Corporation

Environmental care Critical Concern

Bangalore growth statistics

1.6m in 1970 to 2.8m in 1990 and 6.5m today, making it India's fastest growing city, and planners expect it to reach 10m by 2015.

India's IT sector employs 1.3 million people directly, and 3 million indirectly - and 40% of the IT sector is concentrated in Bangalore.

Karnataka State Road Transport Corporation

Mass transport facilities in Bangalore

- Bangalore City Transport
- Plans & Challenges

Introduction of grid routes for Bangalore

Environmental care Critical Concern

Key elements of a successful transport operations :

- Infrastructure.
- State of the art Bus Stations.
- Information system (at bus stations, in vehicles, ticketing and internet services)
- Vehicles and Accessibility.
- Inter-modality and Urban integration.
- Environment care & commuter safety.

Karnataka State Road Transport Corporation

Environmental care Critical Concern

Traffic Planning : Critical Concerns

- Per Capita vehicle ownership
- The road length of Bangalore.
- Dis-incentives for vehicle ownership.
- The polluter pays policy.
- Scraping policy of aged vehicles.
- Clean fuel incentives.
- Awareness on critical impact of automobile pollutants.
- Singapore model of vehicle induction restriction.

Karnataka State Road Transport Corporation

Environmental care Critical Concern

Environment : Critical Concerns

- Air Pollution
- Noise Pollution
- Waste Disposal
- Reduce dependency on Fossil Fuels

Karnataka State Road Transport Corporation

Environmental care Critical Concern

Mitigation of Transport Emissions

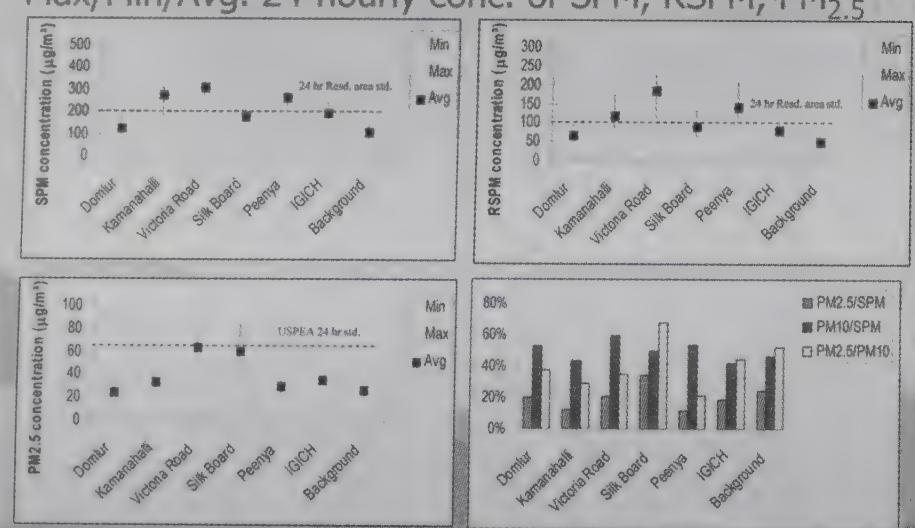
- Fuel efficiency improvements
- System efficiency improvements
- Modal split changes
- Behavioural changes
- Technological changes

Karnataka State Road Transport Corporation

Environmental care Critical Concern

Particulate matter

Max/Min/Avg. 24-hourly conc. of SPM, RSPM, $PM_{2.5}$

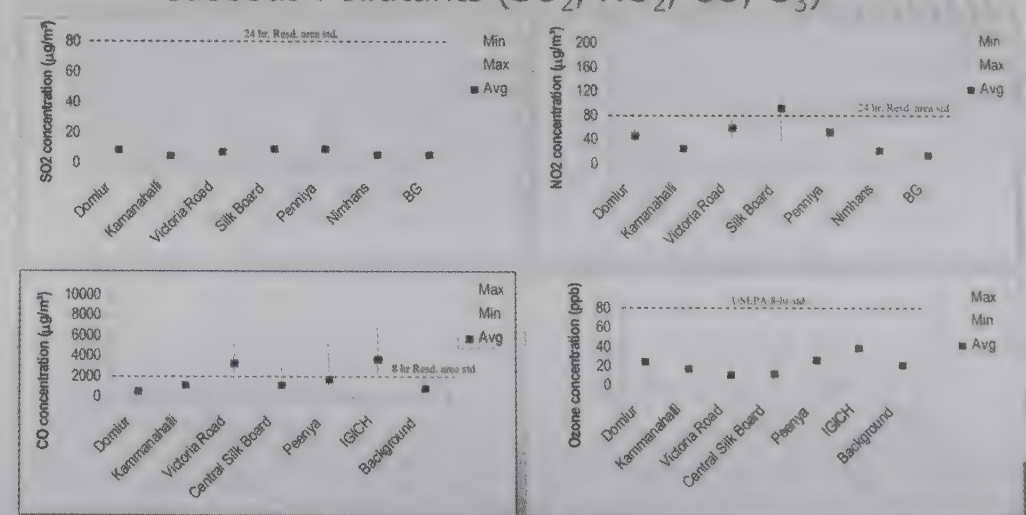


Draft results: not to be quoted till approval by technical committee

Karnataka State Road Transport Corporation

Environmental care Critical Concern

Gaseous Pollutants (SO_2, NO_2, CO, O_3)



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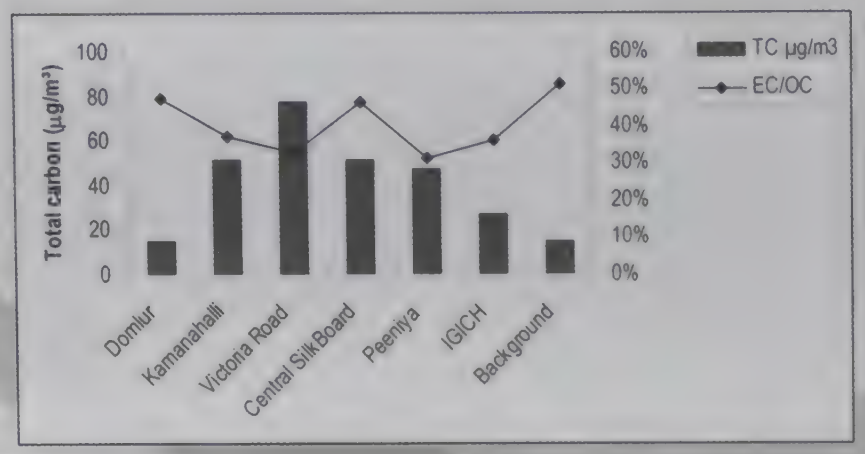
Karnataka State Road Transport Corporation

Environmental care Critical Concern

Carbon Analysis (EC/OC)



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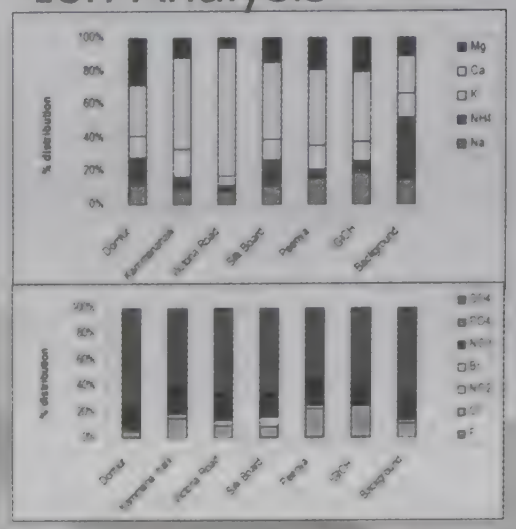
Karnataka State Road Transport Corporation

Environmental care Critical Concern

Ion Analysis



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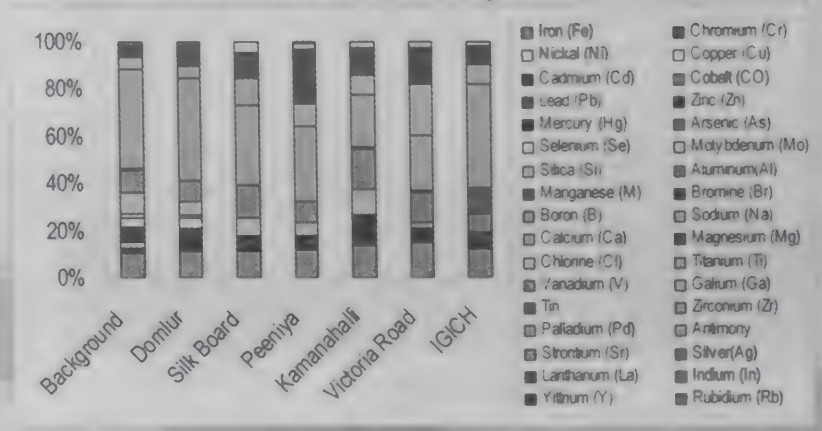
Karnataka State Road Transport Corporation

Environmental care Critical Concern

Elemental Analysis



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Karnataka State Road Transport Corporation

Environmental care Critical Concern

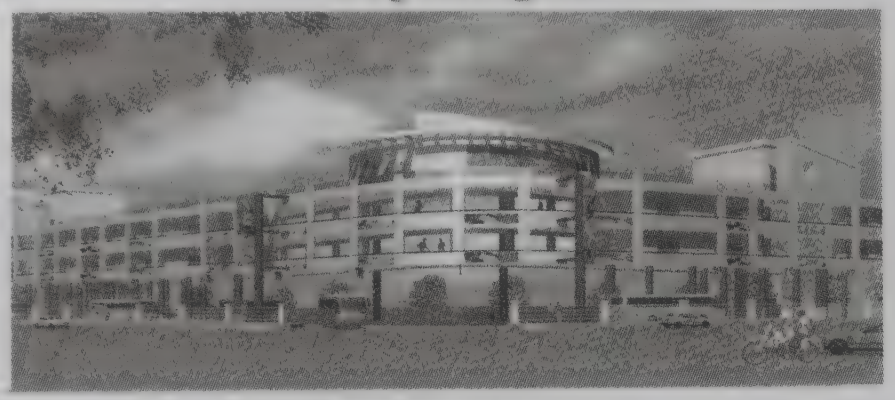
Way Ahead…,

Parking Restrictions
- Staggered Work hours
- City planning – CDP
- Vehicle actuated traffic management.

Karnataka State Road Transport Corporation

Traffic and Transport Management Centre (TTMC) at

Jayanagar



Project Cost: Rs. 10.00 Crores

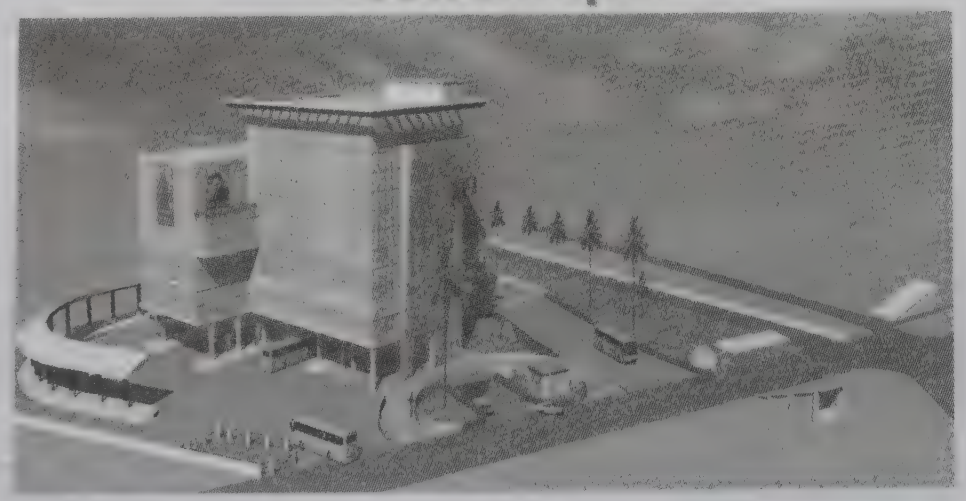
Traffic and Transport Management Centre (TTMC) at

Domlur

Project Cost: Rs. 8.00 Crores

Traffic and Transport Management Centre (TTMC) at

Yeswanthpur

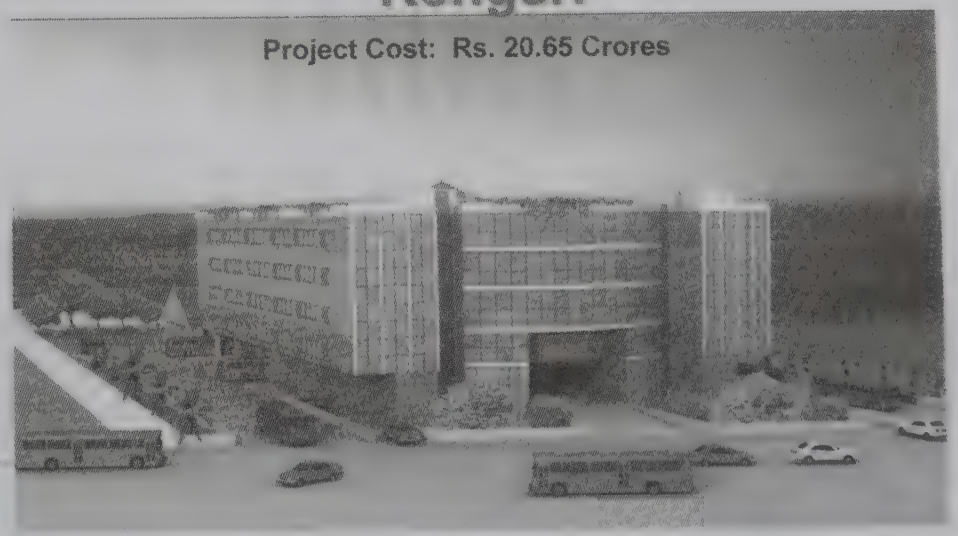


Project Cost: Rs. 25.00 Crores

Traffic and Transport Management Centre (TTMC) at

Kengeri

Project Cost: Rs. 20.65 Crores



Traffic and Transport Management Centre (TTMC) at

Bannerghatta

Project Cost: Rs. 5.11 Crores

Our approach – A Big picture of Goals

- To promote Sustainable Transportation and Mobility by providing 24 X 7 services
- To reduce emissions and introduce Eco-audit
- Up-gradation of technology to increase passenger load factor
- To bring in Zero accident tolerance to reduce the level of accident rate from the present 0.16 to 0.08 (by 50%) per lakh kms performed by public transport vehicles
- To reduce 2 wheeler and 4 Wheeler population growth by 50%
- To increase modal share of BMTC from the 40% (with walk trips) or 32 lakh commuter trips per day to 65% or 57 lakhs commuter trips per day by 2012.
- To enhance average speed of buses to 22.5 kmph from the present 17.5 kmph
- To popularize Direction oriented services through grid System replacing the present destination oriented services
- To bring Clean Development Mechanism (CDM)
- To improve the service standards to ISO 9001 and Environmental standards to ISO 14001

Mr M D N Simha, *KSPCB,* Air quality monitoring and regulation in Bengaluru: Current and future programmes

Air quality monitoring and regulation in Bengaluru
Current and future programmes

By
M.D.N. SIMHA
Chief Environmental Officer
KSPCB

Air Pollution Control Regulation

- Air (Prevention & Control of Pollution) Act 1981
- Objective
  - Prevention, Control & Abatement of air pollution
- Came into force from 16-5-1981
- It was applicable only to the premises of scheduled industries – 20 types of industries
- Air Act was amended in 1987 w.e.f. 1-4-1988
- Schedule was deleted and Act made applicable to the entire State w.e.f.30-5-1988
- Act is applicable to Industrial Plants

Responsibility of KSPCB

- Implement the Air Act through out the State to maintain Ambient Air Quality
- National Ambient Air Quality Standards is notified by CPCB
  - 6 Pollutants viz. SO_2, NO_2, SPM, RSPM, Pb, CO, NH_3
  - 3 types of areas viz. Industrial, Residential, Rural & other Area, Sensitive Area
- SPCB can lay down standards for emission of air pollutants into the atmosphere from Industrial plants & automobiles or any other source (except ship or aircraft) in consultation with CPCB and having regard to the air quality standards laid down by CPCB
- Regulate the emissions from Industrial Plants

Pollution Sources in Bangalore

- Industries
- Diesel Generating Sets
- Vehicles (Total 25 lakhs > 70% 2 Wheelers)
- Construction Activity

Responsibility of Industry

- Obtain prior consent of SPCB to Establish or Operate any industrial plant
- Install & operate Air Pollution Control Equipments and Chimneys as stipulated in the consent
- Keep the control equipments at all times in good running condition
- Not to allow emissions in excess of standards stipulated
- Alter or replace existing control equipments
  or Erect or re-erect chimney
  with approval or as per directions of SPCB

KSPCB action to regulate emissions from Industrial Plants

- Ensure proper siting of industries
- CFE is issued with conditions if site is suitable, otherwise it is Refused
- CFO is issued after verifying compliance to CFE conditions
- Inspection made to verify compliance to CFO conditions
- Actions in case of non compliance
  - Show Cause Notice
  - Legal Sample Collection
  - Personal Hearing
  - Refusal of Consent
  - Apply to Court for restraining a person from causing pollution
  - Issue Directions u/s sec 31A for Closure, Prohibition / Regulation of Industry, Stoppage / Regulation of Electricity / Water /any service
  - Prosecution

Air Quality Improvement Action Plan for Bangalore City

Back Ground

- AAQM results revealed that RSPM levels in Bangalore are higher than limits specified
- Directions issued by the Hon'ble Supreme Court on 14.08.2003 in WP No.13029/85(Civil-PIL) (M.C. Mehta Vs Union of India & others) to the State to draw plan for lowering the rate of RSPM level in Bangalore City.
- 14- point Action Plan is drawn by the State Government for Improvement of Air Quality of Bangalore City vide G.O. FEE 120 ECO 2002 dated 2.12.2003 & 17.1.2004
- Task Force headed by Additional Chief Secretary to Government of Karnataka is monitoring the implementation of Action Plan
- The progress is being reviewed periodically by the EPCA

Departments Involved in Action Plan Implementation

- Forest, Ecology and Environment
- KSPCB
- Home and Police
- Transport
- Food and Civil Supplies and Consumer Affairs
- Bangalore Metropolitan Transport Corporation
- Indian Oil Corporation Ltd.
- Urban Development
- BBMP
- BDA
- Urban Infrastructure Development and Finance Corporation (Special Invitee)
- Commercial Tax
- Excise
- Industries and Commerce
- Bangalore Metro Rail Corporation
- Karnataka Lorry Owners Association
- Southern State Goods Carrier Owners Association
- Karnataka Bus Owners Association
- Bangalore Environment Trust

Action Plan Components

1. Convert in use 3 wheelers to bi fuel mode (LPG & Petrol)
2. Register only new 3 wheelers having bi-fuel mode
3. Setting up of electronic Emission Testing Centres (ETCs)
4. Prevent Adulteration of Fuel
   - Increase Sales Tax and impose entry tax
   - Strengthening Vigilance and Surveillance to check adulteration of fuel
   - To make mandatory for kerosene whole sellers to register themselves and produce end use certificates to Civil Supplies Department
5. Traffic Management
   - One Ways, Construction of Flyovers, Increasing Bus Fleet
6. KSPCB to take action to promote use of cleaner fuels used by major industries in DG sets and boilers
7. KSPCB to install one On-line Ambient Air Quality Monitoring Station

Action Plan Implementation Status

- Conversion of Autos to LPG mode is a success story – 63000 Autos converted out of 68000
- Cleaner fuel (0.035% sulphur) is supplied in Bangalore
- Number of Emission Test Centers increased to 254
- Bus Fleet being increased from 4847 to 5500 by March 2008
- Metro Rail under progress
- Parisara Vahini supplied by KSPCB to Transport Department monitor vehicular emissions
- Price gap between Kerosene and fuel is decreased and inspections increased to prevent adulteration
- 2 CAAQMSs added to the already existing 6 Manual Stations. 7 more planned. One more CAAQM proposed by CPCB
- More Flyovers planned

Future Actions

- Strengthen the monitoring network by adding 7 more manual AAQM stations
- Monitor PM 2.5
- Display of AAQM results at important locations
- Lend support to Source Apportionment Studies being carried out by TERI
- Awareness campaigns to be increased
- Review and Revise the action plans based on the proposed AAQ standards of CPCB

Asthma, lung desease, lung function: Surveillance and pollution

It is well known that air pollution is associated with adverse effects on the respiratory system. Many studies have shown a decrease in lung function and an increase in hospitalisation due to worsening asthma and COPD.

Asthma is defined as a chronic inflammation of the airway, which results in an increase in the bronchial reactivity which results in the classical symptoms of cough, chest tightness and wheeze. These symptoms vary with time or with treatment. The diagnosis of asthma is based on analysis of the symptoms, measuring the airway reactivity or demonstrating reversibility on the lung function. Each of these methods has its advantages and disadvantages. Unlike high blood pressure and diabetes there is no single and definitive test. The asthma screening tools work better if they are done in high prevalence areas and if more than one tool is used. We are in need of a simple and more definite tool. Exhaled breath nitric oxide and exhaled breath analysis are some of the promising tests, which are still undergoing evaluation.

In Bangalore there have been studies looking at the prevalence of asthma. The two major studies are the ISSAC in children and the ICMR study in adults. The two have shown that the prevalence of asthma is significantly more in Bangalore as compared to some of the other cities simultaneously studied. There are also studies, which have shown that the incidence has increased with time. Some studies have even shown that children closer to high traffic density have a higher incidence of asthma. Although there may be a number of confounders we cannot ignore these findings.

There have been many studies on effect of lung function and pollution. A study from California showed that the deficits in FEV, were associated with levels of nitrogen oxide and aid vapour. There are similar studies reported from the UK and Russia. These effects are probably even more relevant because they may be the harbinger of COPD in later life and we have little to offer for this condition other than symptomatic relief of symptoms.

What we need is not to duplicate these results, as it is unlikely to be different and only add to the cost. We would need to develop some method to look at trends so as to be able to determine effects of any intervention. We also need to see how air pollution causes these effects. This may help us to better combat the ill effects of air pollution.

E-100
10830

Asthma, lung disease, lung function surveillance and pollution

George Albert D'Souza MD, DNB

Division of Respiratory Diseases, Department of Medicine
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Definitions

- Screening- process used to identify individual with disease but who are in a preclinical state.
- Case detection - identifies individuals with disease who are symptomatic but undiagnosed.

What is asthma?

Asthma is a **chronic inflammatory disorder** of the airways in which many cells and cellular elements play a role. The chronic inflammation causes an associated increase in bronchial **hyper responsiveness** that leads to **recurrent episodes of wheezing, breathlessness, chest tightness and coughing** particularly in the night or early morning. These episodes are usually associated with widespread but variable **airflow obstruction that is often reversible** either spontaneously or with treatment.

Screening methods

- Questionnaires
- Lung function
- BHR
- Measurements of markers of inflammation in breath condensate

Screening by questionnaire

- ISAAC

1. Have you had wheezing or whistling in the chest in the last 12 months
2. Have you ever had asthma
3. Have you ever had hay fever
4. Have you ever had eczema

- ECRHS

1. Have you had wheezing or whistling in the chest at any time in the last 12 months.
2. Have you ever had asthma
3. Have you ever had any nasal allergies including hay fever
4. Have you ever had eczema or any kind of skin allergies

Screening by questionnaire

- ICMR

a) Have you ever had wheezing
b) Have you ever had chest tightness or breathlessness in the morning

1. Have you ever had asthma or had an attack of asthma in the last 12 months
2. Have you used an inhaler or oral bronchodilator in the last 12 months

SK Jindal et a, Ind J Chest Dis & Alli Sci,2006

ISAAC

- 2.5-18% with questionnaire and 2.5 - 8% with the video questionnaire (1998)
- Asthma symptoms and asthma were not related to pollution levels
- Prevalence 6.5% and > 4 episodes in 1 year 1.9%.
- Change in prevalence .02 %/year from ISAAC I to III
- Low prevalence areas ↑, high prevalence areas plateau

ICMR

	Wheezing	Chest tightness	Respiratory symptoms	Asthma
Bangalore	4.3%	3.3%	10.5%	3.5%
Kanpur	2.8%	2.7%	9.8%	2.1%
Delhi	2.1%	2.5%	6%	1.7%
Chandigarh	2.5%	2.5%	4.7%	2.3%

SK Jindal et a, Ind J Chest Dis & Alli Sci,2006

ECRHS

Wheeze	4.4
Wheeze & breathlessness	2.9
Wheeze & no cold	2.1
Chest tightness	7.5
Cough at night	11.2
Asthma attack	2.7
Asthma medication	2.7
Diagnosed asthma	3.5

Chowgule,RV AJRCM, 1998

ECRHS

Mumbai	Wheeze	Asthma
	4	3.5
Goteborg	23	5.8
Hamburg	21	4.4
Cambridge UK	25	8.4
Paris	14	5.1
Wellington	27	11.3
Melbourne	29	11.9
Portland USA	25	7.1

Bangalore and asthma

Year	Prevalence(%)
79	9
84	10
89	18
94	24
99	29

Bangalore & Asthma(Children)

Group		n	%
I	Heavy traffic affluent	3722	19
II	Heavy traffic less affluent	273	31
III	Low traffic affluent	2565	11

Proximity to traffic and lung development

Freeway distance	FVC	FEV_1	MMEF
< 500	- 63	-81	-127
500 - 1000	-31	-41	-35
1000 - 1500	-19	-33	-94

Gauderman WJ, Lancet 2007

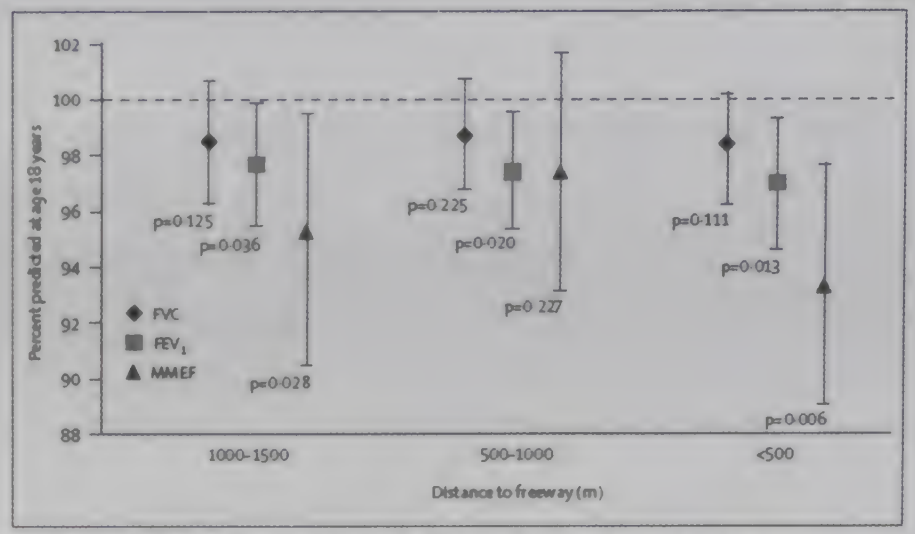
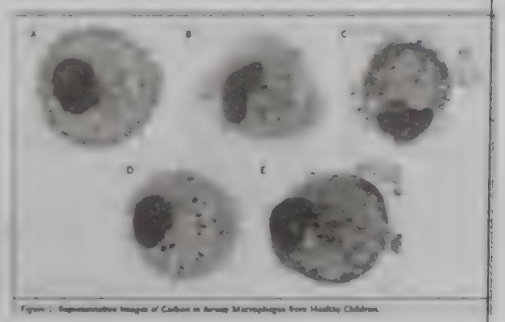


Figure: Percent-predicted lung function at age 18 years versus residential distance from a freeway
The horizontal line at 100% corresponds to the referent group, children living >1500 m from a freeway.

Proximity to traffic and lung development

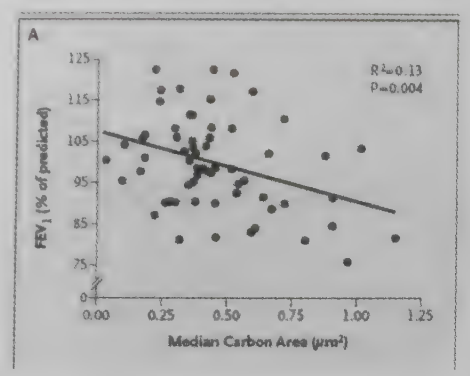
Pollutant		< 500	500 -1000	1000-1500
Ozone-37ppm	-13	-81	-41	-33
NO_2 34.6ppm	-109	-80	-41	-33
Acid-51.4μg/m³	-111	-80	-41	-33
PM10-22.8 μg/m³	-111	-81	-42	-32
PM 2.5 - 1.2 μg/m³	-101	-80	-41	-33

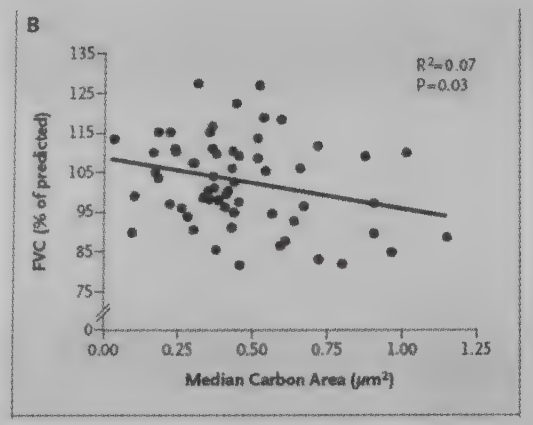
Carbon in airways and lung function in children



Lung function	Correlation	p
FEV_1	- .3	. 02
FVC	- .24	.05
FEF_{25-75}	- .3	.02

Neeta Kulkrni, NEJM 2006





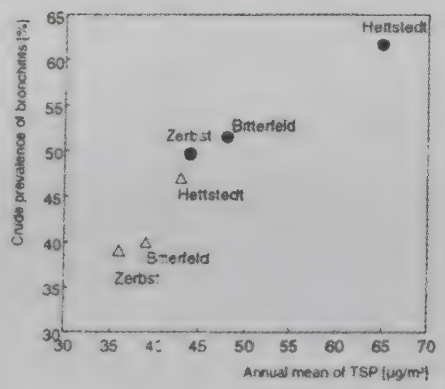
Neeta Kulkrni, NEJM 2006

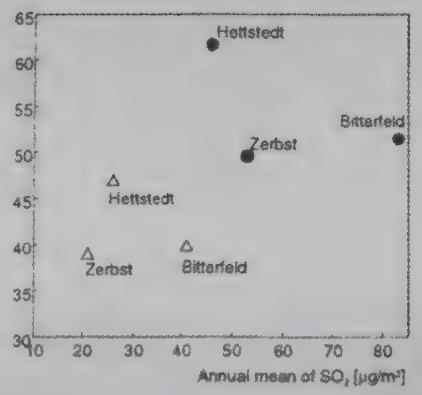
Decrease in exposure and improved lung function

Variable	↓PM10	↓interval exposure	P value
FEV_1	2.2ml	9.9	.02
FVC	4.2ml	9.3	.006
FEF_{25-75}	11.3ml	15.4	.047

Sara H Downs NEJM 2007

Respiratory symptoms and pollution

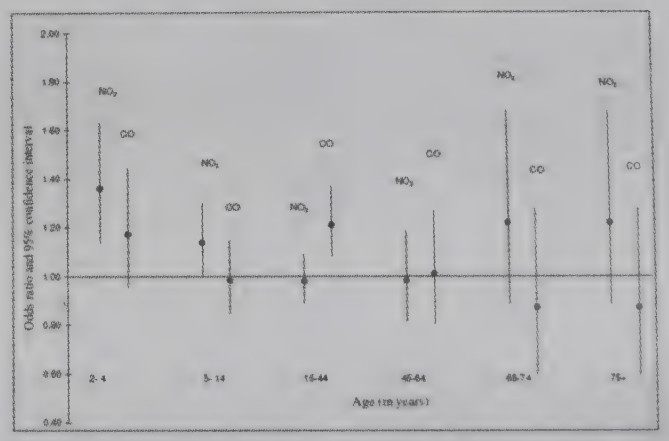




Heinrich J AJRCCM 2000

Pollution & ER visits for asthma

- 50 % increase ER visits with increase in ambient NO_2 and CO
- > in children (5 –14 years) and elderly (>65years)



Paul J Villeuenve Environmental health 2007

Conclusion

- Effect lung development
- Effect lung function
- Increased respiratory ailments – obstructive airway disease,recurrent coughs and colds, Increased ER visits
- Can be reversed with improved air quality

What we need?

- Monitoring and dissemination of air quality
- Monitoring lung disease
  - Lung function
  - ER visits

Testimonies of air pollution affected persons

Ms Jayamma, *Garbage worker*

I have been a sweeper for the past 14 years. I started on a salary of Rs.1400 per month which has gone up to Rs.1900 today. The administration is not sympathetic to our plight and provides neither footwear nor gloves. The salary we get is much less than the amount sanctioned by the government and does not even suffice to procure provisions and pay our children's school fee. Due to long working hours during which we are not allowed to rest, most of us suffer from back and knee pain and respiratory problems. The contractors use any pretext to deduct our wages. If we are seen without the single shirt provided as uniform, two days' wages are deducted.

On behalf of other sweepers I request everyone here to help us get better work conditions.

Ms Rajamma, *Quarry worker*

Before I became a member of an NGO, I worked as a bonded laborer at a quarry. The NGO helped me and several others like me out of bondage. We worked under very difficult conditions. The area surrounding the quarry was used as garbage dumping area. As a result we had to constantly inhale unhealthy air while we worked. Most of us quarry workers suffer from asthma and other respiratory problems. Some have even been diagnosed with TB.

Master Affroze (10 years), *Rescued child labourer*

I am from Mandakki bhatti where I worked as a child laborer. I was released by an organization through an UNICEF supported initiative. I used to carry heavy loads of puffed rice on my back from one place to another. Inhaling the foul air of the bhatti has permanently affected my breathing. Today I suffer from severe asthma. Also my back is bent.

Mr Kotturesh, *UNICEF volunteer*

When UNICEF set up a base in Davangere, Karnataka, in 2002 I became a volunteer with them. Child labour is rampant in the puffed rice kilns located in this region. To cut costs, used tyres are used as cheap fuel. All workers particularly children, develop breathing problems from the air pollution. Asthma and bronchitis have been on the rise. My organization set up health camps in this area. Our reports reveal that children are more prone to these respiratory infections than adults. Nearly a thousand children have been taken away from there but before all of them could be rescued UNICEF wound up the project. We need to revive it and rescue those children.

Ms Laksmamma, *Garment worker*

I am from Peenya and have been working for the past 10 years as a button operator in a garment factory there. My colleagues and I are exposed to a lot of dust and to the chemicals that are used for washing the garments. We are not provided any masks so we inhale the dust directly. Most of us are plagued by respiratory problems. Cough is commonplace among all the workers and so is exhaustion. We are not supplied with gloves so we cannot protect our hands from needle pricks. Constant back ache is another occupational hazard we face. If the seating arrangements can be improved this can change. Other problems can also be solved if the employers want.

Ms Jayashree, *Activist,* QWARIDS

Has the system been able to respond to the plight of "aam admi" who is affected by air pollution?

My organization helps to free bonded laborers working in quarries and allied industry. We believe that at least part of Bangalore's rapid growth is at the cost of bonded laborers and other workers who work under extremely bad work conditions. The implements used to break boulders in quarries generate a lot of dust which the workers inhale and develop acute respiratory problems. Men, women, children and pregnant women all work in these heavily polluted conditions. Not wanting to miss even the meager wages they get, new mothers return to work with the infants

soon after delivery. This jeopardizes those tender lives as well. Rural areas adjacent to the quarries face pollution because of the waste from the quarries being dumped there.

Although the village health committee and panchayat members along with government officials have supplied masks to these workers they are hesitant to use them. In their desperation for wages they overlook health considerations altogether.

Early learning centres have been opened for children to keep them away from the quarries. The centres are also used to provide information on health issues to the adults. Evening schools are run for children who missed education while working as child labour.

Much more needs to be done to help these people and we will keep trying.

Discussion:

Q The need of the hour is a good public transport system. Is there an agency that can manage it in Bangalore like the bus rapid transport does in Mysore?

A *There are coordinated agencies like the MUDA which are coming to a single platform infrastructure. Visits abroad have brought in a lot of criticism and suggestions. What we require now are dedicated policies at the state and national level. There should be a fuel policy, a transport policy, and a bio fuel policy.*

Q How long will it take to arrive at a city centric approach?

Will production of bio fuel lead to deforestation?

When bio fuel becomes a disaster do we have any form of disaster management for that? Bio fuel positive energy is 1.5 to 1.8 units of energy and it does not account for biomass used in production. Ethanol with efficiency of 28% lesser energy is got. How long can we have a eucalyptus point of view?

A *Ethanol is produced from molasses; hence there is no question of deforestation. Right now we are focusing on bio diesel from non edible seeds. The ethanol used in the CDM project is the first of its kind in the world.*

Q What about energy balance? In Brazil it is 4.5 to 5 units, in India it is 1.6 to 1.8 which is less than 28% of energy. There is a total negative value.

A *When we talk about calorific value the project design document will provide all relevant information. Also there will not be any energy loss during transportation of the fuels as it will be produced in and around the region.*

Q In Kalasipalya fake 2T and TT oils are available in the market. There is no way in telling the difference. If we use these oils some serious pollution is going to be caused. The police and the authorities have taken no action despite complaints.

If 68,000 autos have been converted to gas, why can the same principle not be used on buses and cars?

A *If 2T and TT are adulterated, a special task force has been formed and they will check into the matter. Dealers sell 2T instead of 4T due to profit gain.*

And about cars and buses being converted, it would probably be the next step.

Q Glass buildings are not eco friendly and yet the upcoming project of the BMTC shows extensive glass being used.

A *About the proposed buildings a second review shall be considered to reduce the amount of glass being used.*

Q Why can't the corporation regulate the dust level on roads which accounts for 20% of the pollution?

A *To make money the contractors employ only 15 cleaners where 30 are required. Only concerted efforts by citizens can tackle these issues.*

Plenary Session 3:
Other experiences and broader issues

Chair: Mr Paritosh Tyagi

EFFECTS OF AIR POLLUTION ON EYE

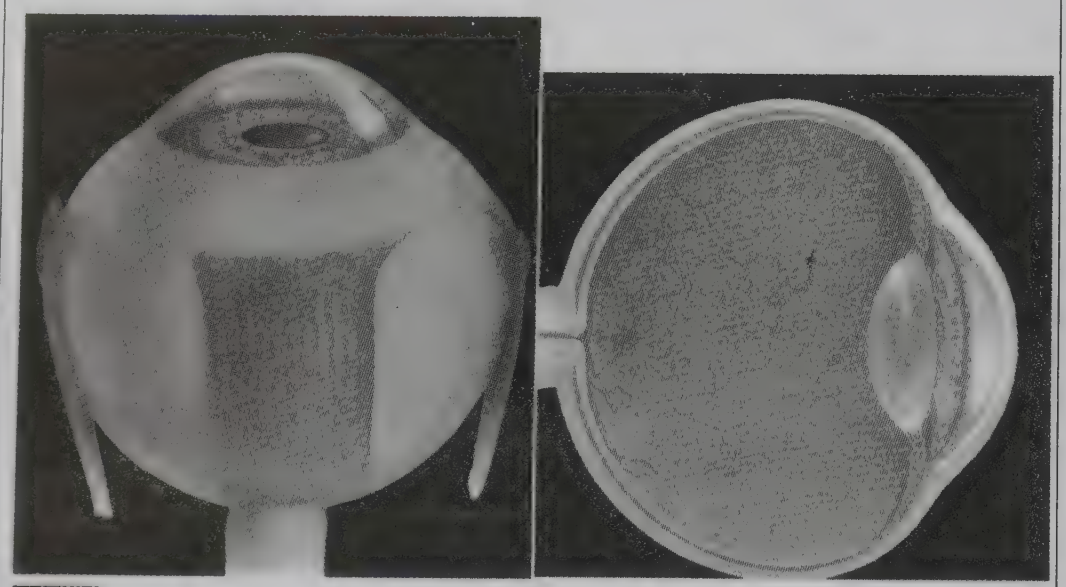
DR. A VENKATACHALAM

CONSULTANT OPHTHALMIC SURGEON

Hyderabad Eye Hospital

ANATOMY

Eye has three layers viz sclera, choroid and retina covered by a thin membrane



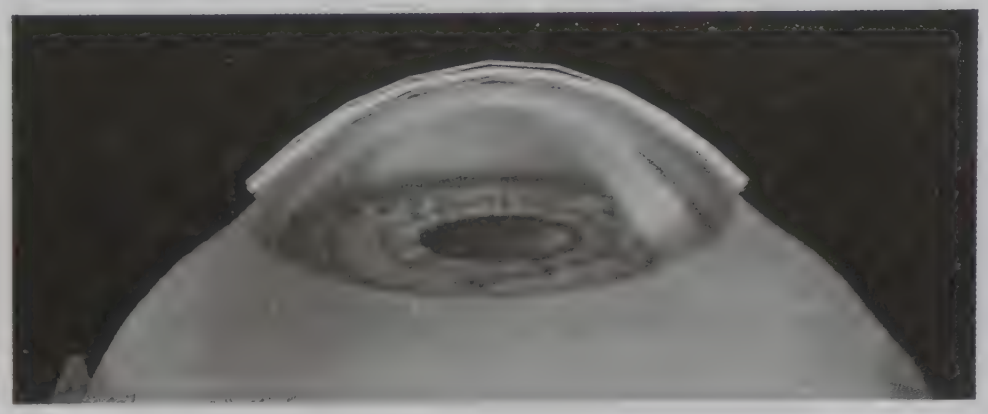
TEARS

Eye ball is kept moist and is lubricated by a tear film

TEAR FILM

Constituents of tear film

- Tear film has three layers
  - Lipid
  - Aqueous
  - Mucin



TEAR FILM

Mechanically spreads over ocular (eye) surface by frequent blinking

FUNCTIONS OF TEAR FILM

- Provides atmospheric O^2 to the eye
- Anti bacterial function – Lysozyme
- Washes a way debris & noxious substances
- Gives smooth optical finish to cornea by frequent lubrication

AIR POLLUTION

Common problem globally and it is increasing day by day

TYPES OF AIR POLLUTION

- Primary
- Secondary

PRIMARY AIR POLLUTION

These pollutants are emitted directly from known source

CLASSIFICATION OF PRIMARY AIR POLLUTANTS

1. Fine particles (<100μ in diameter)
   - Particles of metal carbon
   - Tar, Resin
   - Pollen, Fungi, Bacteria
   - Oxides, Nitrites, Sulfates

CLASSIFICATION OF PRIMARY AIR POLLUTANTS

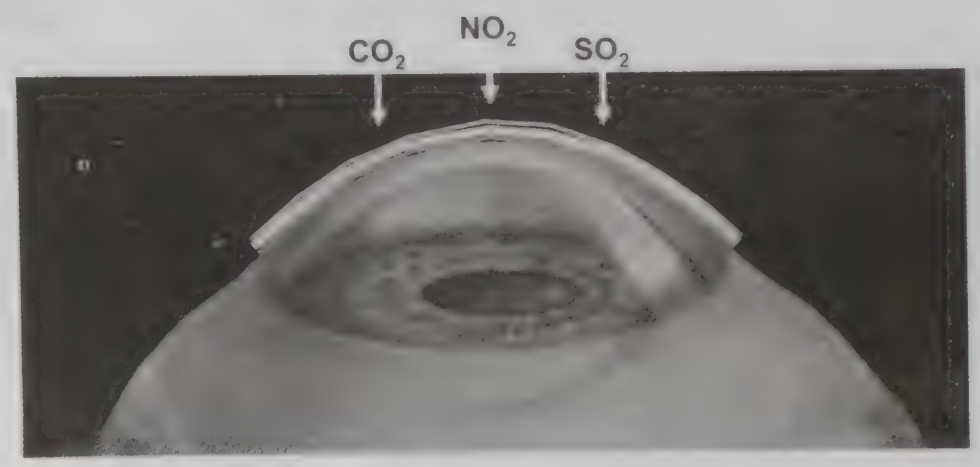
2. Coarse particles (>100μ in diameter)

- Because of their mass they are removed rapidly by air and gravity

CLASSIFICATION OF PRIMARY AIR POLLUTANTS

3. Compounds of sulphur, nitrogen, carbon and halogen

- Sulphur dioxide
- Sulphuric acid mist
- Nitric oxide
- Ammonia
- Saturated and un saturated aliphatic and aromatic hydro carbons, carbon dioxide & carbon monoxide



CLASSIFICATION OF PRIMARY AIR POLLUTANTS

4. Radio active compounds

SECONDARY AIR POLLUTANTS

These pollutants are produced in the air by interaction of two are more primary pollutants <u>or</u> by their reaction with normal atmospheric constituents

SECONDARY AIR POLLUTANTS

- Sulphur dioxide reacts with oxygen in presence of moisture to form sulphuric acid misted
- No2 → No+0

SECONDARY AIR POLLUTANTS

- Nitric oxide, Nitrogen Dioxide, Hydrocarbon

↓ Photo chemical reaction

Ozone (O3) and
Peroxy Acetyl Nitrates (PAN)

SYMPTOMS DUE TO AIR POLLUTANTS AFFECTING THE EYE

- Burning or stinging
- Gritty or scratchy sensation
- Soreness
- Dryness
- Itching
- Pain
- Mucus
- Tearing

VISUAL SYMPTOMS

- Blurred vision or reduced visibility
- Vision fluctuation
- Light sensitivity

REDUCED VISIBILITY

- Brought about by scattering of light from surface of air borne particles
- Degree of scatter is related to particle size, aerosol density and thickness of affected air mass
- Both primary & Secondary can reduce visibility

SMOG (SMOKE + FOG)

- SO_2 and particulate matter are chief offenders
- Causes irritation
- Increased sensitivity to light of a dark adapted eye

CARBON MONOXIDE

- Major constituent of air pollution
- Increases carboxy hemoglobin (COHb) levels in the body
- At about 5% of COHb levels, impairment of visual discrimination is seen

PREVENTION

- Goggles
- Educating people
- Control through various legislature methods at local National and International
- Decrease green house effect by having plenty of trees

IMPLICATIONS OF URBAN PLANNING ON AIR POLLUTION RELATED HEALTH RISKS

Prof.S.Shiva Kumar,
Professor of Architecture,
MSRIT,Bangalore

To broadly focus on :

- Cities & Sustainable Development,
- Environmental Health risks in metropolitan cities, the case of Bengaluru, to emphasize environmental health risks that are specifically accentuated in Bengalooru **because of its present urban plan**
- What is being done to tackle the air pollution related health risks,
- What should be done by Government agencies, air quality managers and concerned citizens,
- To what extent are c) and d) being done,
- **Some best practices from India & abroad,**
- **What priority should be set for air pollution abatement programme and other observations.**

Emergence of Cities

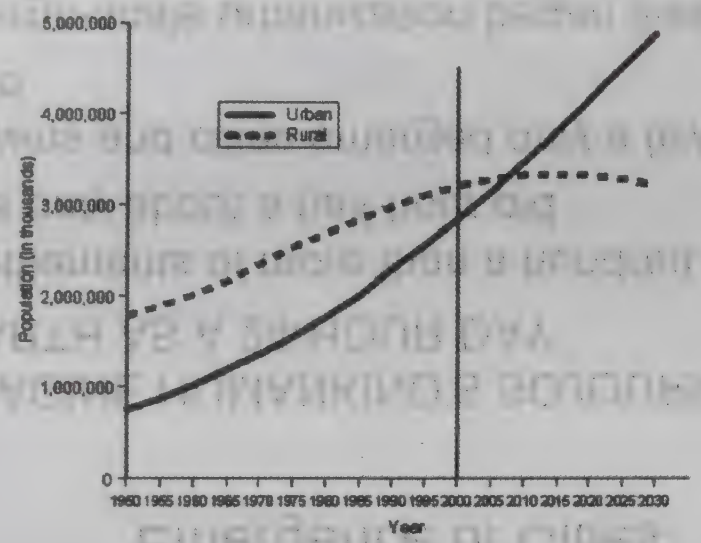
IMAGINE HUMANKIND'S SOJOURN ON EARTH AS A 24-HOUR DAY

- Settlements of more than a hundred people are only about a half-hour old
- Towns and cities emerged only a few minutes ago
- Large-scale urbanization began less than 60 seconds ago

The urban explosion

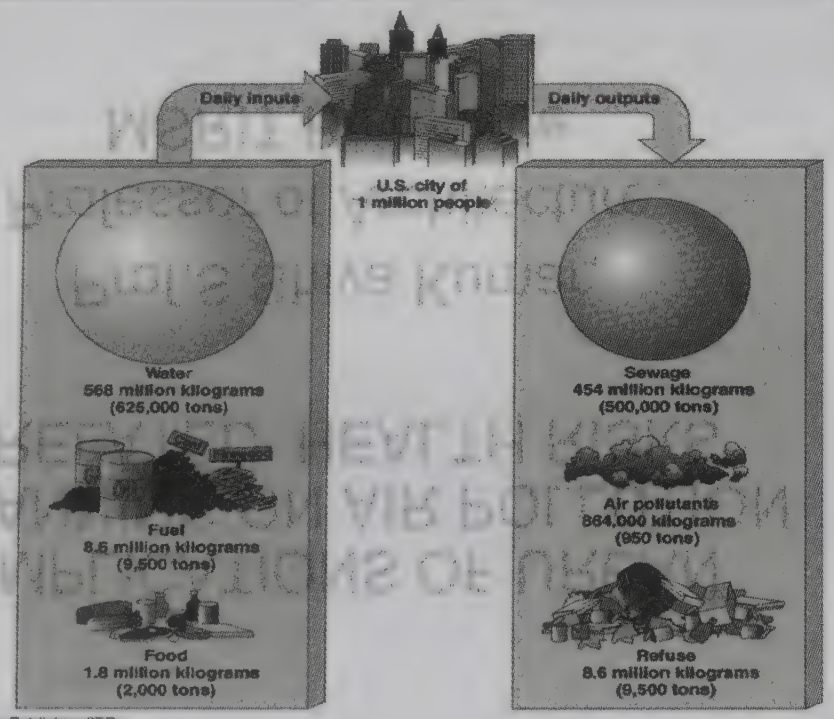
- Urban population growth is the most important change in population geography.
- About 50% of the global population, 3 billions, lives in cities.
- Almost all the population growth between 2000 and 2030 will occur in cities.
- By 2050, 6.2 billion people will live in cities, more than the current (2000) population.
- Much of this growth will come in the world's poorest countries.

World Population Growth will be Mainly Urban



Ecological Footprint of an Urban System

- Per capita requirement in USA:
  - 2 acres of agricultural land
  - paper and wood products from 1 acre of forest land
  - 2000 gallons of water per day
- A city with 1 million inhabitants will require:
  - 2 million acres of land for food
  - 2 billion gallon of water



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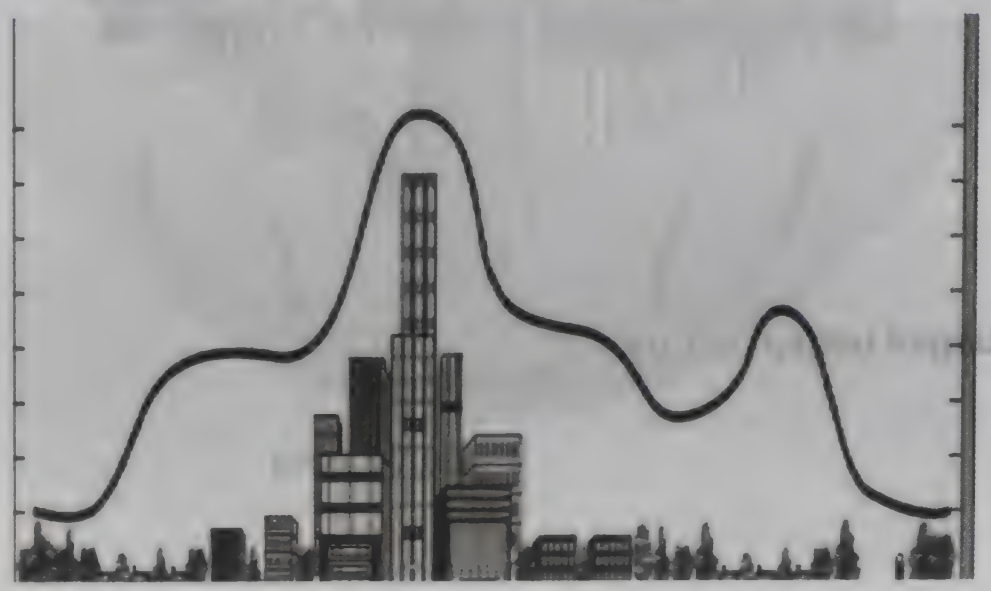
Urban Pollution

- Urban residents suffer higher pollution levels than surrounding rural areas.
- Sheer numbers of people in cities mean urban areas are major contributors to air pollution and enhanced greenhouse effect.
- Most urban residents suffer from excessive noise.

Urban Microclimate / Pollution

- Materials used in urban construction: conduct more heat than vegetated areas
- Buildings and vehicles: release significant amounts of heat energy from burning of fossil fuels
- Urbanization has its own **microclimate**
- Temperature of a city: several degrees warmer than surrounding rural areas
- Cities are **urban heat islands**

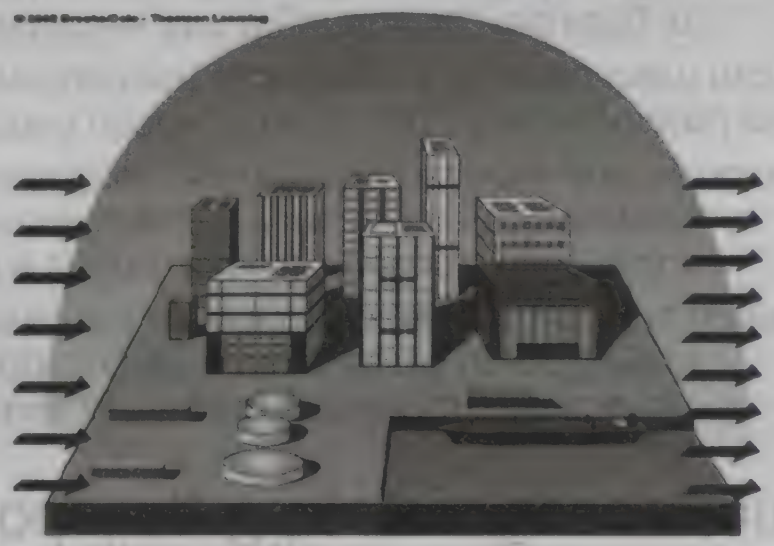
Urban Heat Island



What Causes Heat Islands?

- Displacing trees and vegetation
- minimizes the natural cooling effects ofshading and evaporation of water from soil and leaves
- Tall buildings and narrow streets can heat air that is trapped between them and reduce wind flow.
- Waste heat from vehicles, factories, and air conditioners may add warmth to the air, further increasing temperatures.

Urban Areas: Inputs and Outputs
-no self-sustaining systems



Sustainable Cities

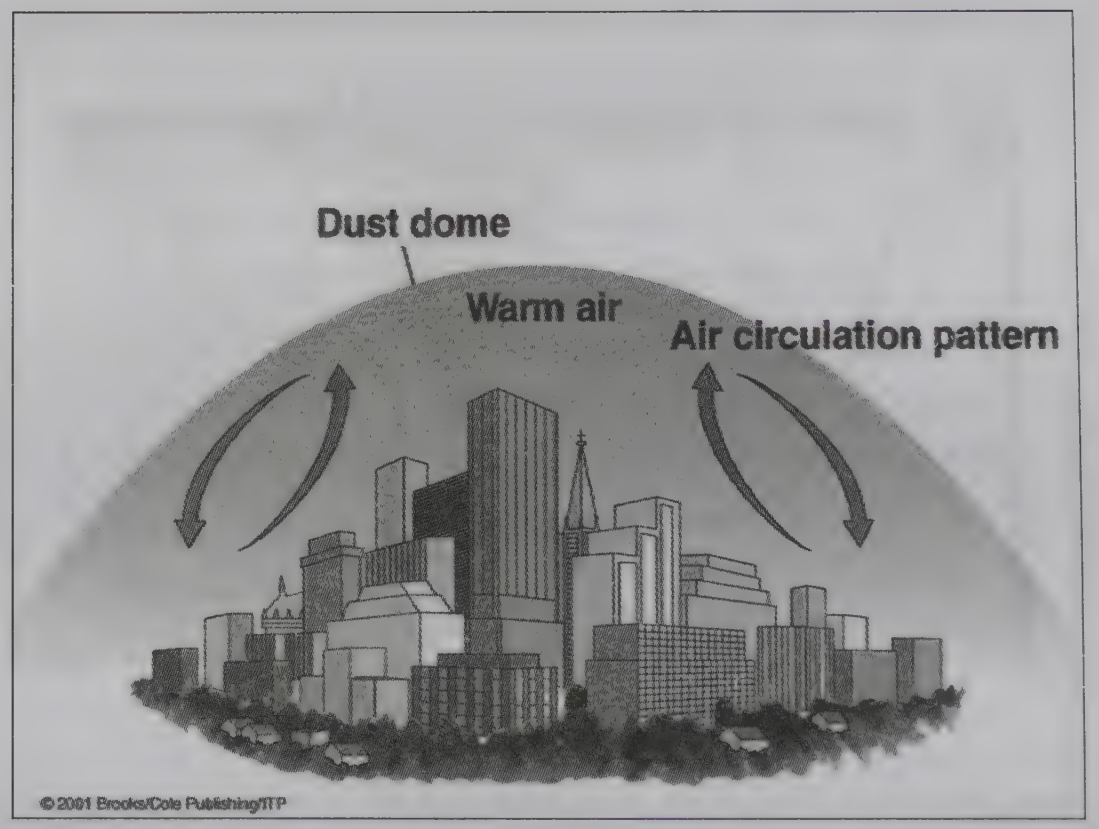
- **Sustainable city**: takes only the resources that are needed, can be continuously recycled, or returned to the environment in the least harmful way
- In reality, no city is *completely* sustainable.

Modeling Cities on Ecosystems

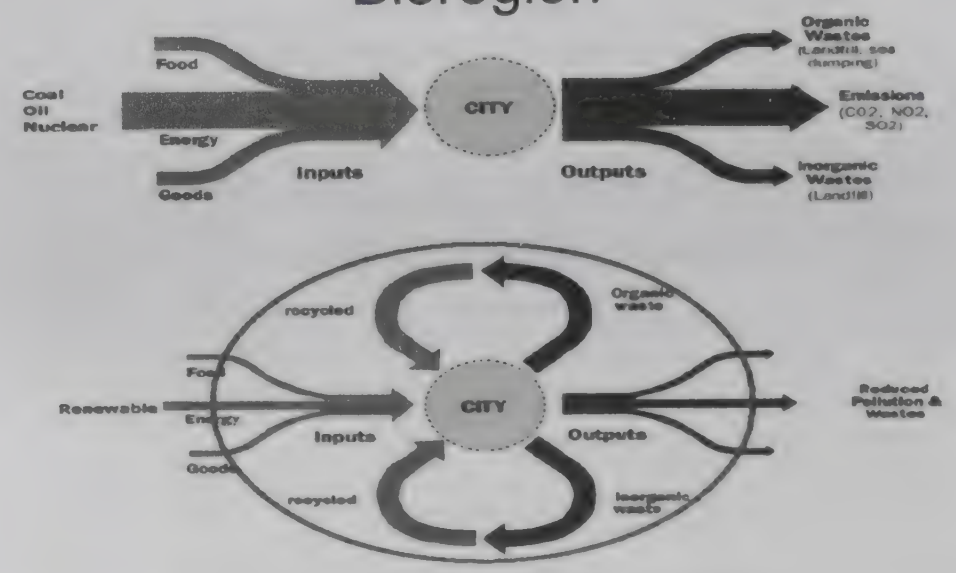
- Cities can become more sustainable by modeling urban processes on ecological principles by which natural ecosystems operate
- The characteristics of ecosystems include diversity, adaptiveness, interconnectedness, resilience, regenerative capacity and symbiosis
- These characteristics can be incorporated in the development of strategies to make them more productive and regenerative, resulting in ecological,social and economic benefits

Sustainable Cities

- Minimal environmental impact of development and its operations
- Eco-friendly technologies, respect for ecology and value of natural systems
- Energy efficiency
- Less use of finite fuels
- More local production
- More walking, less driving



From Linear to Circular Metabolism within the Bioregion



Green City

- Imagine a city where buildings use solar power to help generate their own energy, and waste less because they use power-saving lighting and are well-insulated, where public transport is affordable and efficient, where vehicles pollute less because they are powered by electricity or hydrogen. That city has become part of the solution, not the problem. It is the city of the future. With the support of communities, businesses and, above all, governments, it can also be the city of today.

Klaus Toepfer, Executive Director UNEP

LAND USE & AIR QUALITY

- Cities in developing countries like India are facing some of the same concerns that North American cities are: congestion and urban growth. However, the concern in cities like New Delhi is that this growth is far more rapid as both urbanization and motorization are ongoing processes that have not yet peaked.
- Furthermore air quality in major Indian cities is now becoming a major concern with TSP (Total Suspended Particulates) levels at dangerously high levels. By examining the land use change and its relationship with transportation and air quality in a spatial context it is possible to pinpoint locations for concern. Like many urban processes the spatial nature of these problems is self-evident.
- Air quality affects the various strata in the population differently depending on where they live and people live in different parts of the city depending on their socio-economic status.
- Studies indicate that land use in the in our cities are rapidly intensifying and that planners and policy-makers need to address industrial, commercial and infrastructure location in order to plan for a more sustainable city.

Transportation and Land-use Planning

- Land-use planning, perhaps the most powerful regulatory tool that can be used to address vehicular emissions, is seldom being used by most Asian countries
- Governments and development institutions have started to place an increasing emphasis on urban transportation issues, particularly on public transportation
- International organizations have acknowledged the direct relationship between climate change mitigation and the promotion of public transportation and have initiated several projects on this
- Several countries in Asia have now started to develop sustainable urban transportation policies promoting public transportation, i.e. Bus-rapid transit
- In China, the Vice Minister of Construction, Qui Baoxing, has ordered city authorities to improve and maintain cycling facilities and in to order to restore the country's title as the "kingdom of bicycles"

Cities constitute small area but eats away large share of resources

The present day cities unwittingly disrupt the ecosystems upon which they depend. To avoid this, should we not be reconsidering how we define city systems, both conceptually and in spatial terms? As presently conceived, cities are incomplete ecosystems, typically occupying less than 1 percent of the productive area upon which they draw. In whole-systems terms, 'the city' comprises not just this tiny node of consumption, but also the complementary productive hinterland.

NATIONAL AMBIENT AIR QUALITY PROGRAMME

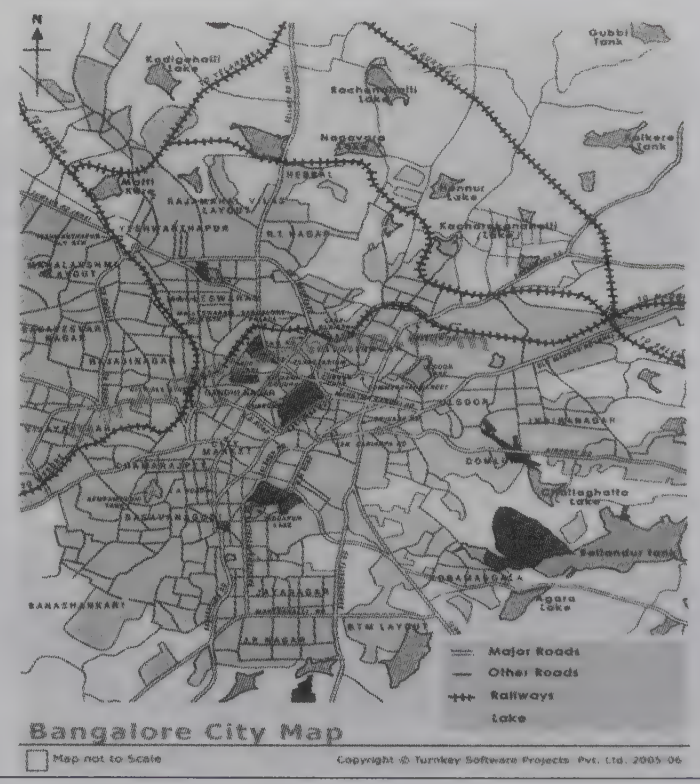
The RSPM concentrations are higher in winter season and are lower during monsoon months. A plausible explanation for these results may be found by examining meteorological conditions. During the winter season, average mixing height is lower as compared to other seasons and atmospheric dispersion is typically at a minimum and therefore the pollutants will not be as widely dispersed. Lower average mixing height in winter season results in less volume of troposphere available for mixing and hence higher concentrations. Calm conditions in winter season result in less dispersion of pollutants resulting in building up their levels. The monsoons results in large amount of precipitation, high wind velocities and changes in general wind direction. The large amounts of precipitation reduce atmospheric pollution via associated wet deposition processes. Further wind velocities will allow for pollutant transport away from sources and increase mixing processes, thereby resulting in lower levels.

Non-attainment Areas

CPCB has identified list of polluted cities in which the prescribed National Ambient Air Quality Standards (NAAQS) are violated. These cities have been identified based on ambient air quality data obtained under National Air Quality Monitoring Programme (NAMP). Action plans are being formulated and implemented to control air pollution in non-attainment cities by respective states.

S. no. State/Union Territory City Major Sources of Pollution Pollutants of Concern

1**Andhra Pradesh**HyderabadVehiclesRSPM, SPMVisakhapatnamVehicles, IndustriesRSPM, SPM
2**Assam** GuwahatiVehicles, IndustriesRSPM, SPM
3**Bihar** PatnaVehicles, Natural DustRSPM, SPM
4**Chandigarh** ChandigarhVehicles, IndustriesRSPM, SPM
5**Chattisgarh** BhilaiIndustriesRSPM, SPMKorbaIndustriesRSPM, SPMRaipurVehiclesRSPM, SPM
6**Delhi**DelhiVehiclesNO2, RSPM, SPM
7**Goa** PanajiIndustries, VehiclesSPM
8**Gujarat** AhemadabadVehicle IndustriesRSPM, SPMAnkleshwarIndustriesRSPM, SPMJamnagarIndustries, VehiclesRSPM, SPMRajkotVehicles, Natural DustRSPM, SPMSuratIndustries, VehiclesRSPM, SPMVadodaraVehicles, IndustriesRSPM, SPMVapiIndustriesRSPM, SPM
9**Haryana** FaridabadVehicles, IndustriesSPMYamuna NagarIndustries, VehiclesSPM
10**Himachal Pradesh** DamtalNatural DustSPMPaonta SahibNatural DustSPMParwanooIndustries, Natural DustRSPM, SPMShimlaNatural DustSPM
11**Jharkhand** DhanbadIndustriesNO2, SPMJamshedpurIndustriesNO2, SPMJharaiaIndustries, Natural DustSPMSindriIndustries, Natural DustSPM
12**Karnataka** BangaloreVehicleRSPM, SPMMysoreVehiclesRSPM
13**Kerala** KottayamVehiclesRSPMKochiVehicles, IndustriesRSPM, SPMThiruvanan-thapuramVehiclesRSPMKozhikode Natural DustRSPM
14**Madhya Pradesh** BhopalVehicleRSPM, SPMIndoreVehiclesRSPM, SPMJabalpurVehiclesRSPM, SPMNagdaIndustriesSO2, RSPM, SPMSatnaIndustriesRSPM, SPM
15**Maharashtra** Chandrapur IndustriesRSPM, SPMMumbaiVehicles, IndustriesRSPM, SPMPuneVehiclesNO2, RSPM, SPMNagpur VehiclesRSPM, SPMNashik VehiclesRSPM, SPMSolapurVehicles, Natural DustRSPM, SPM
16**Meghalaya** Shillong VehiclesRSPM
17**Orissa** AngulVehicles, Industries, Natural DustRSPM, SPMRayagadaIndustriesRSPMRourkelaIndustriesRSPM, SPMTalcher IndustriesRSPM
18**Punjab** GobindgarhIndustriesRSPM, SPMLudhianaVehicles, IndustriesRSPM, SPMJalandharVehicles, IndustriesRSPM, SPM
19**Rajasthan** AlwarVehicles, Natural DustNO2, RSPM, SPMJaipurVehiclesRSPM, SPMJodhpurNatural DustRSPM, SPMKotaVehicles IndustriesNO2, RSPM, SPMUdaipurVehicles, Natural DustNO2, RSPM, SPM
20**Tamil Nadu** ChennaiVehicle IndustriesRSPM, SPMMaduraiVehiclesRSPM, SPMCoimbatoreVehiclesRSPM, SPMTuticorinVehiclesRSPM
21**Uttar Pradesh** AgraVehicle IndustriesRSPM, SPMAnpara IndustriesRSPM, SPMKanpur Vehicle, IndustriesRSPM, SPMLucknow VehicleRSPM, SPMGajraulaIndustriesRSPM, SPMNoidaVehicles, Natural Dust, IndustriesRSPM, SPMVaranasiVehicles, Natural DustRSPM, SPM
22**Uttaranchal** DehradunVehicles, Natural DustRSPM, SPM
23**West Bengal** KolkataVehicles, IndustriesRSPM, SPM, NO2HaldiaVehicles, IndustriesRSPM, SPM, NO2HowrahVehicles, IndustriesRSPM



BENGALURU

- Located on the Deccan Plateau in the south-eastern part of Karnataka, Bangalore has an estimated metropolitan population of 65 lakh (6.5 million), making it India's third most populous city and fifth-largest metropolitan area.
- Though historically attested at least since 900 CE, recorded history of the city starts from 1537, when Kempe Gowda I, widely regarded as the founder of modern Bangalore, built a mud fort and established it as a province of the Vijayanagara Empire. During the British Raj, Bangalore developed as a centre for colonial rule in South India.
- The establishment of the Bangalore Cantonment brought in large numbers of migrants from other parts of the country. Since independence in 1947, Bangalore grew to become the capital of Karnataka state. Today, as a large and growing metropolis in the developing world, Bangalore continues to struggle with problems such as air pollution, traffic congestion, and crime. Home to some of the most well-recognised colleges and research institutions in India, the city has the second-highest literacy rate among the metropolitan cities in the nation.

Bengaluru & its evolution

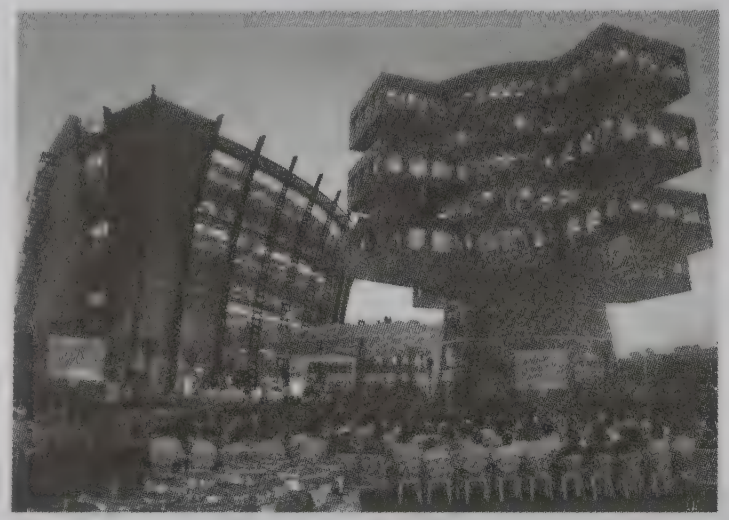
- Modern Bangalore was founded by a vassal of the Vijayanagara Empire, Kempe Gowda I, who built a mud fort and a Nandi Temple in the proximity of modern Bangalore in 1537. Kempe Gowda referred to the new town as his "gandu bhoomi" or "Land of Heroes".
- Within the fort, the town was divided into smaller divisions called "petes" (IPA: [peɪteɪ]). The town had two main streets Chickkapete Street, which ran east-west, and Doddapete Street, which ran north-south. Their intersection formed the Doddapete Square — the heart of Bangalore. Kempe Gowda's successor, Kempe Gowda II, built four famous towers that marked Bangalore's boundary.
- In the 19th century, Bangalore essentially became a twin city, with the "pete", whose residents were predominantly local people, and the "cantonment" created by the British.
- Bangalore was hit by a plague epidemic in 1898 that dramatically reduced its population. New extensions in Malleshwara and Basavanagudi were developed in the north and south of the pete. Telephone lines were laid to help co-ordinate anti-plague operations, and a health officer was appointed to the city in 1898. In 1906, Bangalore became the first city in India to have electricity, powered by the hydroelectric plant situated in Shivanasamudra. Bangalore's reputation as the Garden City of India began in 1927 with the Silver Jubilee celebrations of the rule of Krishnaraja Wodeyar IV. Several projects such as the construction of parks, public buildings and hospitals were instituted to beautify the city.
- Bangalore experienced rapid growth in the decades 1941–51 and 1971–81 , which saw the arrival of many immigrants from northern Karnataka. By 1961, Bangalore had become the sixth largest city in India, with a population of 1,207,000.
- Bangalore has developed into one of India's major economic hubs and is today counted among the best places in the world to do business.It is home to numerous public sector heavy industries, software companies, aerospace, telecommunications, machine tools, heavy equipment, and defence establishments. Known for a long time as the *Garden City of India* and *Pensioner's paradise*, Bangalore today is commonly referred to as the "Silicon Valley of India" due to its pre-eminent position as India's technology capital.

Bengaluru-Some climatic aspects

- The topology of Bangalore is flat except for a central ridge running NNE-SSW. The highest point is Doddabettahalli, which is 962 m (3,156 ft) and lies on this ridge. No major rivers run through the city, though the Arkavathi and South Pennar cross paths at the Nandi Hills, 60 km (37 mi.) to the north. River Vrishabhavathi, a minor tributary of the Arkavathi, arises within the city at Basavanagudi and flows through the city. The rivers Arkavathi and Vrishabhavathi together carry much of Bangalore's sewage. A sewerage system, constructed in 1922, covers 215 km² (133 mi²) of the city and connects with five sewage treatment centers located in the periphery of Bangalore.
- In the 16th century, Kempe Gowda I constructed many lakes to meet the town's water requirements. The Kempambudhi Kere, since overrun by modern development, was prominent among those lakes. In the earlier half of 20th century, the Nandi Hills waterworks was commissioned by Sir Mirza Ismail (Diwan of Mysore, 1926–41 CE) to provide a water supply to the city. Currently, the river Kaveri provides around 80% of the total water supply to the city with the remaining 20% being obtained from the Thippagondanahalli and Hesaraghatta reservoirs of the Arkavathy river. Bangalore receives 800 million litres (211 million US gallons) of water a day, more than any other Indian city. However, Bangalore sometimes does face water shortages, especially during the summer season in the years of low rainfall. A random sampling study of the Air Quality Index (AQI) of twenty stations within the city indicated scores that ranged from 76 to 314, suggesting heavy to severe air pollution around areas of traffic concentration Bangalore has a handful of freshwater lakes and water tanks, the largest of which are Madivala tank, Hebbal lake, Ulsoor lake and Sankey Tank.
- Due to its high elevation, Bangalore usually enjoys salubrious climate throughout the year, although freak heat waves can make things very uncomfortable in the summer A common refrain among Bangaloreans is that summer has gotten progressively hotter over the years. This could be due to the loss of green cover in the city, increased urbanization and the resulting urban heat island effect, as well as possibly climate change.

Air Quality Management-Bengaluru

- Local Administration has taken several measures to address the air pollution challenge.
- Imposing PUC certification, promoting LPG fuelled vehicles, easing congestion, constitution of a Task Force etc.
- Conducting public awareness programmes
- Poor appreciation of the problem, lack of capacity, personnel shortage, a sense of resignation are a few impediments



OK FOLKS.. LOOKS LIKE THE TRAFFIC STARTED MOVING AGAIN .. WILL CONTINUE OUR MEETING AT THE NEXT TRAFFIC JAM.. KEEP MOVING TOGETHER...
—CHETAN—

Getting the Private Sector to Invest in Road and Air Quality Improvement-Ahmedabad

Along the five-kilometer-long C.G. Road in Ahmedabad, India, a very simple road cross section design has dramatically improved through-traffic flows by separating through-traffic and service lanes. At the same time, the amount of managed parking space was increased, and simple paving and landscaping reduced dust re-suspension [3]. All this was funded by a consortium of private firms who were given advertising rights in return.

The Environmental Benefits Mapping and Analysis Program (BenMAP),Mumbai

Digital Urban Management Programme- Bangalore GIS Model

- Objective is to enhance, facilitate & promote efficient use of GIS
- Encourage interagency cooperation through shring of data
- Provide accurate spatial reference base
- DUMP envisions a future where gIS is recognised as an integral tool for Government & business

Kawasaki Eco-town

- The Eco-Town policy first introduced in Japan in 1997.
- Not simply an ecological town , but a town where **economy** and **environment** are integrated

Have Air Quality Standards Helped In mitigating Air Pollution Related Health Risks

Dr. Rajendra Prasad

Indian Association For Air Pollution Control

NewDelhi110 020

Email : envirotech@eth.net

Bangalore 22-23 Jan 2008

What Is Air Quality Standards

- Air Quality Standards are the concentration of pollutants notified by regulator used as criteria to pass or fail quality of air.
- The standards are based on basics of science , available technology, prevailing environmental conditions and their effect on various component of environment with focus on human health and vegetation. Thus different countries have different Standards.
- Standards are also revised to improve the air quality, to overcome observed problems in implementation,to overcome pressures of societies, to reduce health problems,to match technological advancements& to ensure comparability with other countries including polluters interferences.

Thus AQ Standard are policy tools for AQ management

Air Pollution And Community Health

- Air pollutants levels in Indian cities including medium size towns stay much above the Standard(except SO_2 and at some places NO_2)
- Thus these are often termed as polluted, unsafe and un-breathable.
- The relationship between ambient atmospheric concentration (Particulates and Gaseous Pollutants) and community health is much less clear and not quantified in India for framing the standard at all.
- Health implications depend upon composition,nature,shape and size of particulates and their peak and avg.levels in specific periods.Such factors are rarely looked into.
- Respiratory diseases like Flu, Asthma, Tonsillitis ,Bronchitis and other Lung diseases all are caused by air pollutants. Particulates play a major role in affecting the incidence as vehicle of pathogenic infection to cause these problems frequently.

All these aspects needed much better scientific data ,objective discussions and deeper examination for framing and notifying Ambient Air Quality Standards

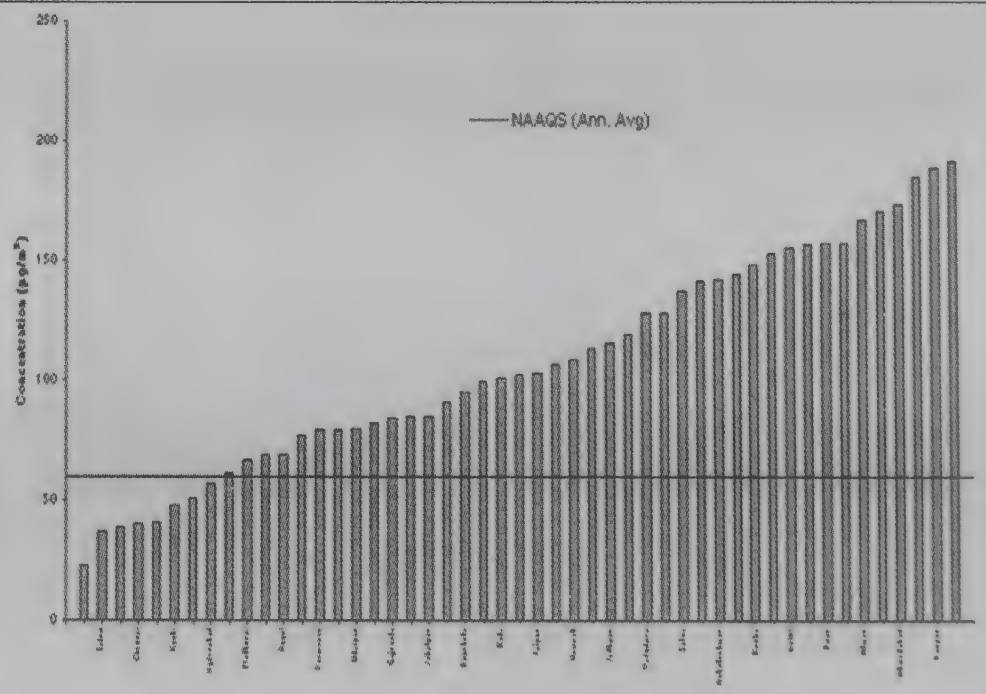


Figure 5.23. Annual Average Concentration of RSPM in Residential Areas of various cities/towns during 2002

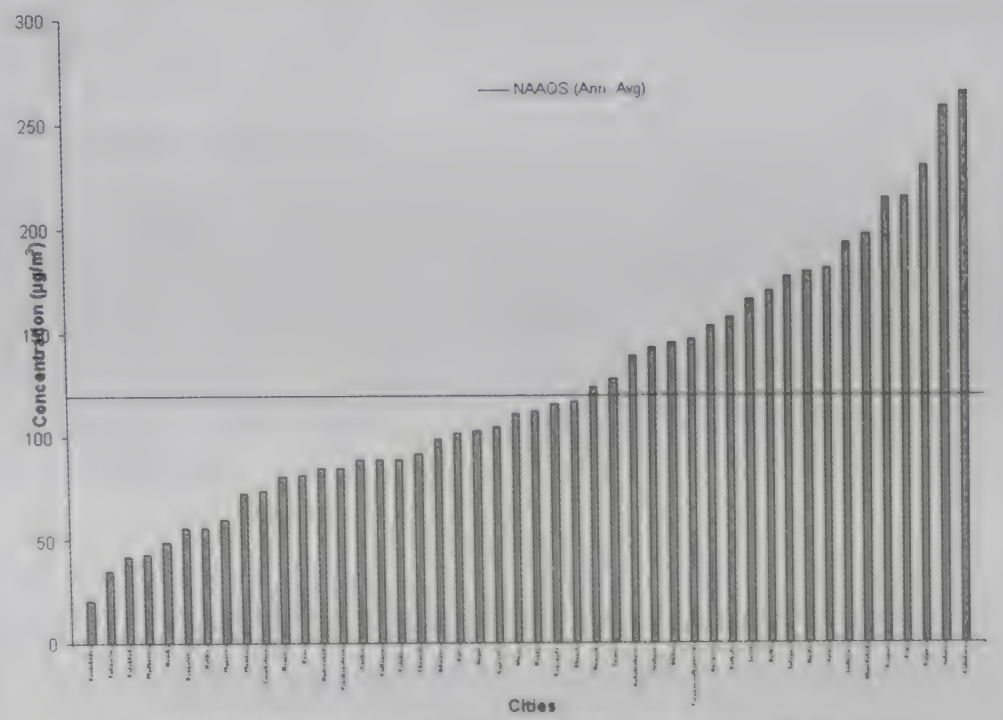
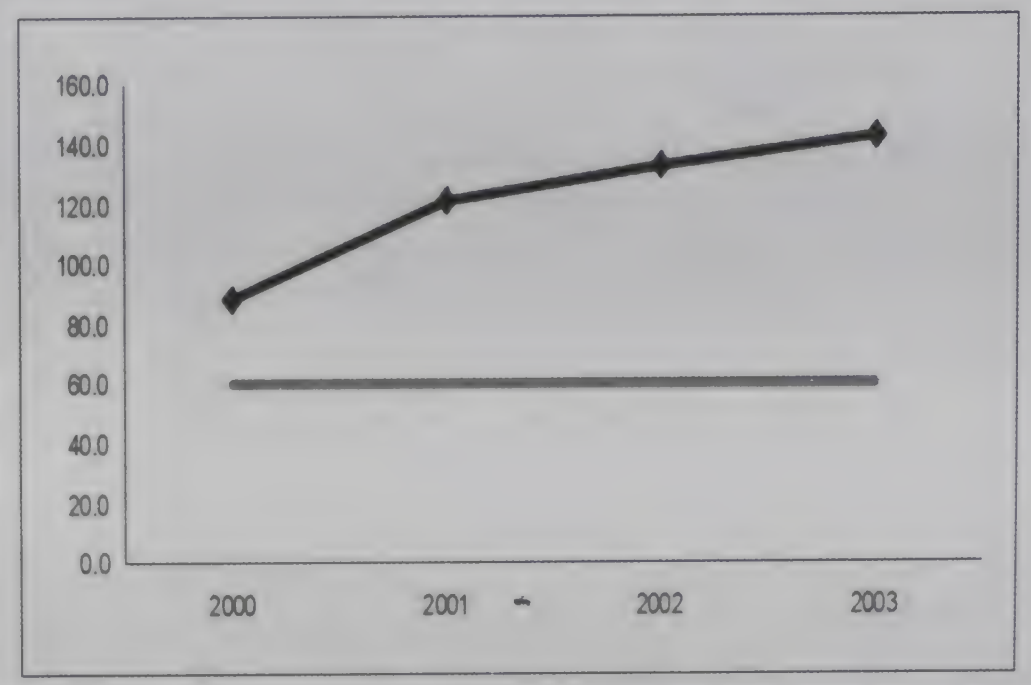


Figure 5.24: Annual Average Concentration of RSPM in Industrial Areas of various cities towns) during 2002.

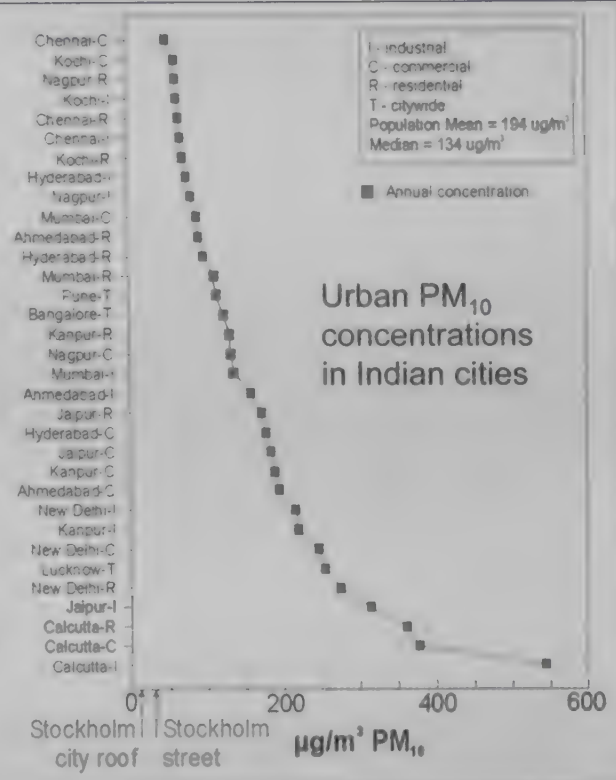


Urban Particulate Matter

Particulate matter one of the major air pollution causes of mortality and morbidity

PM_{10} and $PM_{2.5}$ used to characterise exposure

About 62 million people live in these cities in India



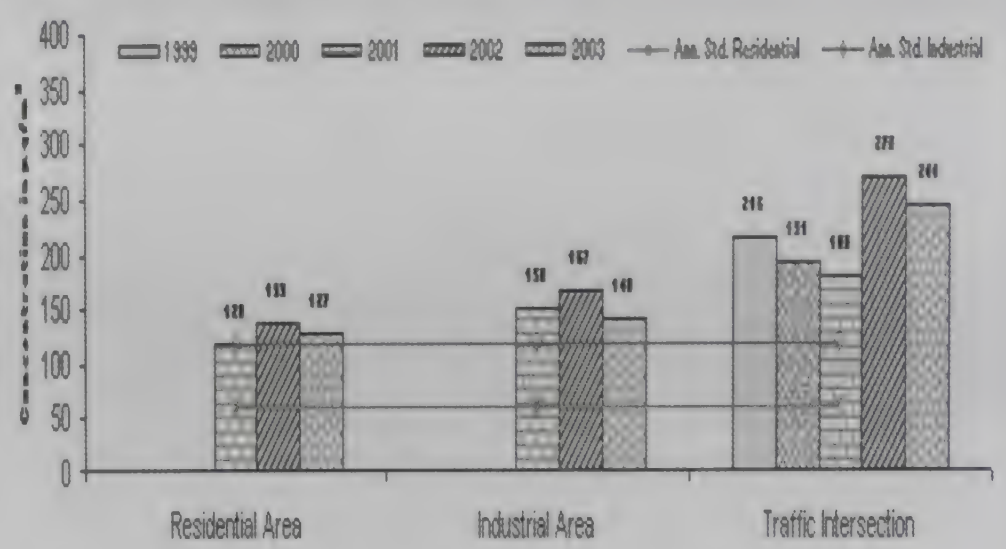
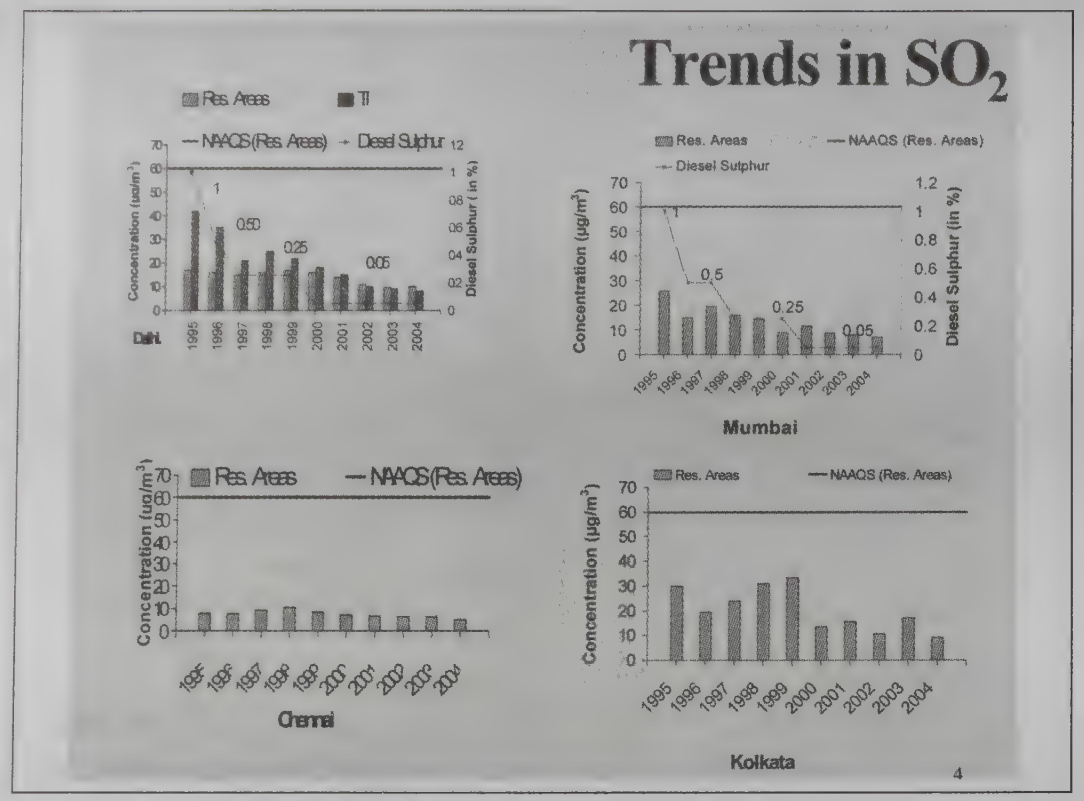
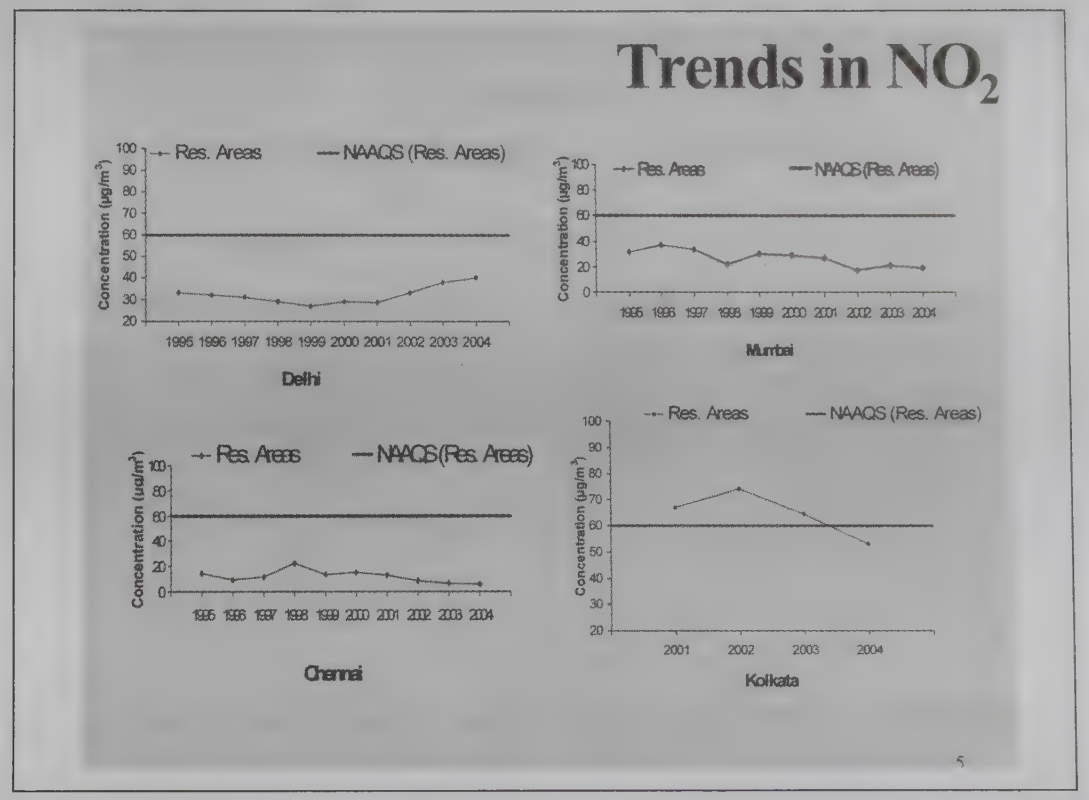


Fig 5.32 Respirable Suspended Particulate Matter Concentration in Ambient Air of Delhi (1999-2003)





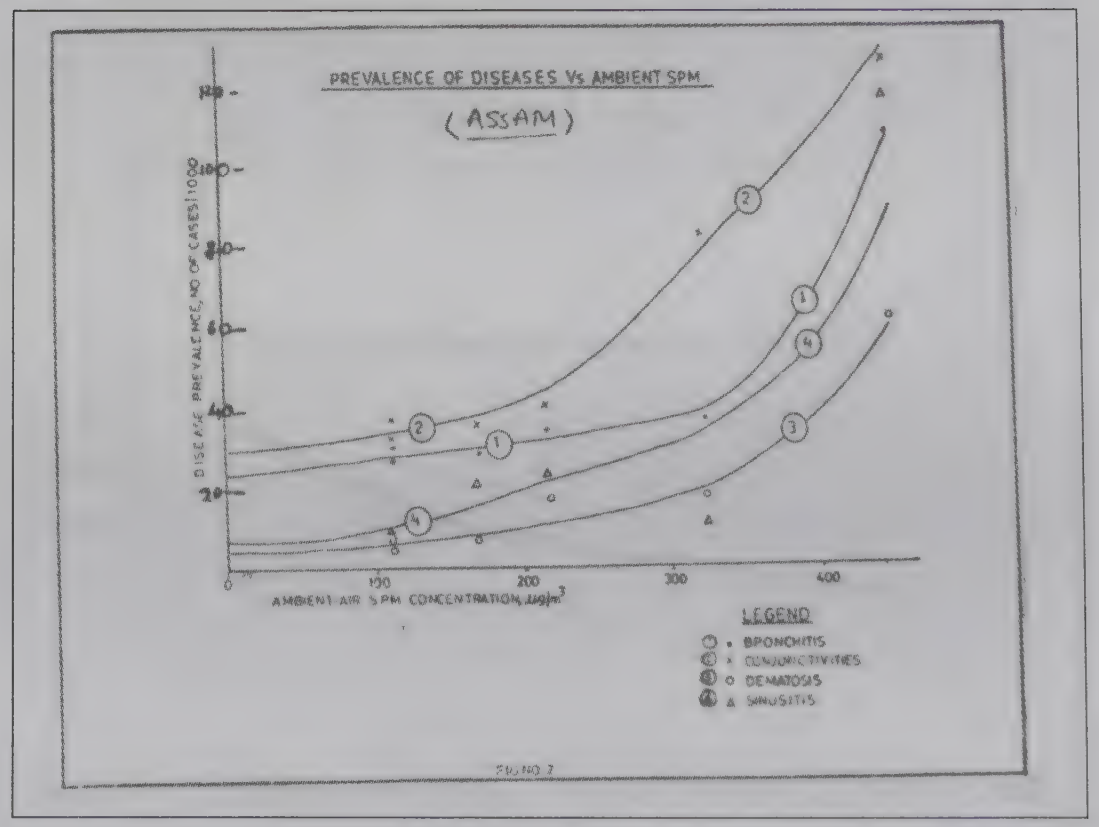
CONCLUSION OF AIR QUALITY MONITORING (LAST TEN YEARS)

Critical Pollutants (exceeded the standard)

- RSPM (PM_{10})
- Carbon Monoxide
- Benzene
- Ozone (some places)
- Polyaromatic Hydrocarbon (Benzo – a- Pyrene)
- Oxides of Nitrogen (Some places)

Within Standard

- Sulphur Dioxide
- Lead



Air Quality Standards Are Incomplete

- Standard for all parameters are not existing .It is difficult to find out which parameter is triggering the effects on human health, crops and on other components of environment.
- There are no standards for indoor air quality where individuals are spending much more time compare to out doors.
- Duration of Standard are not practical.
- Due to large differences in micro meteorological factors in vast country like India giving uniform AQ standard making them impractical and irrational.

Vehicular Pollution In cities

- Vehicular Pollution is most critical cause of air pollution in urban areas.
- MOST approach has been to control the pollution by enforcing better vehicle design and maintenance.
- MOST has totally failed in combating such pollution.No policy and plans likely to maintain the air quality of the cities due to VP.
- Compliance is not satisfactory due to large number of old vehicles, poor maintenance ,poor fuel quality,poor road conditions , traffic congestion and unbelievable over-loadings of almost all vehicles in city.Further number of vehicles is increasing 2-3 times in 10 years.

If air quality in urban area to be maintained limit on number of vehicles have to be planned and implemented.

Another Health Hazard By Vehicles in Delhi

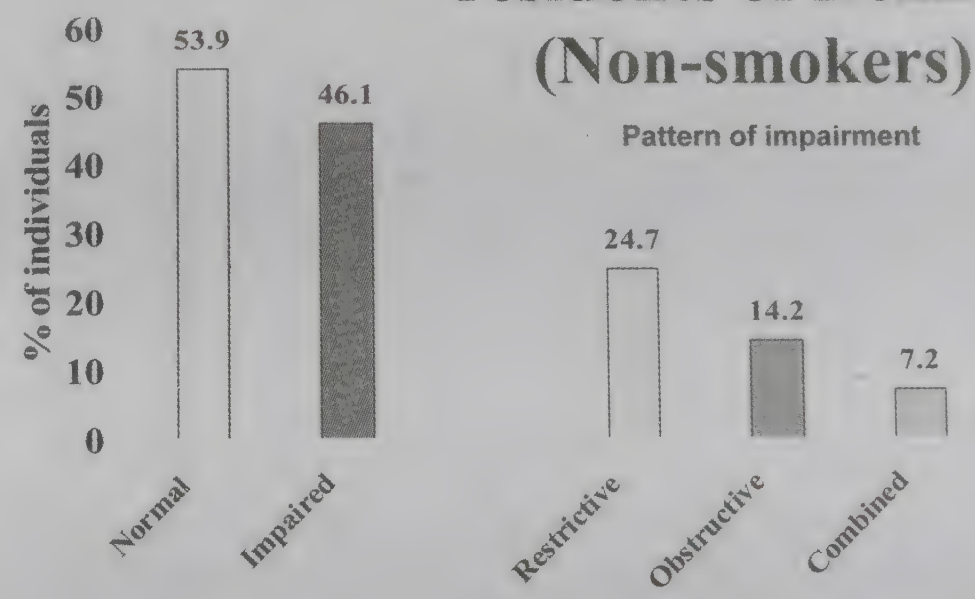
Type of Vehicle	No of Vehicles	No. of Wheels Tyre	Total Weight New Tyres	Total Weight of Old Tyres at changing time	Period of Replacement	Rubber loss to atmosphere per year	Qty Of Rubber by Total Number per year
Buses	24774	6	300kg	210	2 year	45kg	11 14 830
Goods vehicle (Truck Tempo)	135671	6	300kg	210	2 year	45kg	61.05.195
Car/Jeeps/Taxis	1267852	4	28kg	18	3 year	5kg	63 39 260
Auto Rickshaw	74906	3	15kg	8	2 year	3kg	2 24 718
Scooter/Motor Cycle	2650241	2	10kg	7	3 year	1kg	26 5 0241
Total Quantity of Rubber Kg going to atmosphere per year							16.43.4.244
Total Quantity of Rubber Kg going to atmosphere per day							45,149
Total Quantity of Rubber Kg going to atmosphere per Hour							1.881

- **A number of these vehicles are also expected to go out of Delhi but at the same time many vehicles of other states are also entering in Delhi. A balance has been assumed.**
- Tyre rubber contain toxicant including heavy metals in traces thus their impacts on urban population are significant. Control/protective measures are urgent need to avoid severe impacts of these constitutes getting in to the atmosphere without any regulation

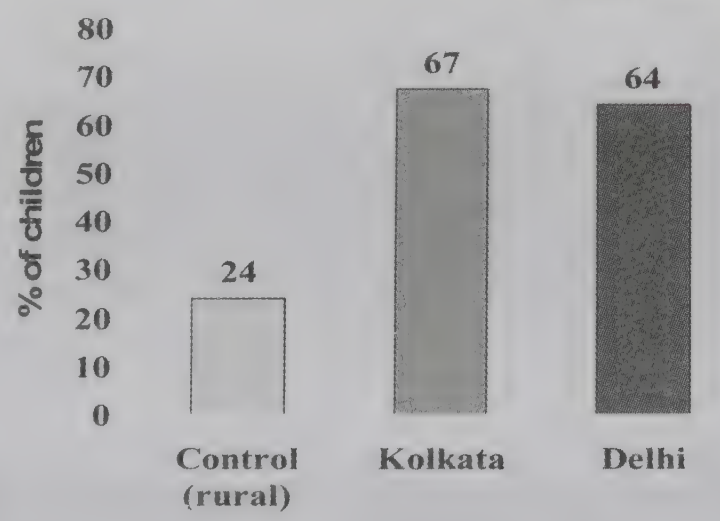
Air quality Standard And Community Health

- Community health data neither obtained from the hospitals nor generated in parallel to air quality data to understand the role .
- Hospitals are existing almost in all areas may be requested to compile disease data of the community useful for correlating with AQS. Govt.hospitals are maintaining some records.
- Medicines consumption became 5-6 times in last 10 years clearly indicating that health problems are rising continuously.
- No.of cases registered for respiratory diseases are increased several times and are dominating other diseases.
- Fine dust has been found one of the main cause for cardiovascular diseases, asthma ,excess deaths.
- Mortality rates are found associated with level of pollutants .WBPCB study indicate that with 25ug/m3 increase of Pm10 concentration no of deaths are increased by 6-7% in the area.

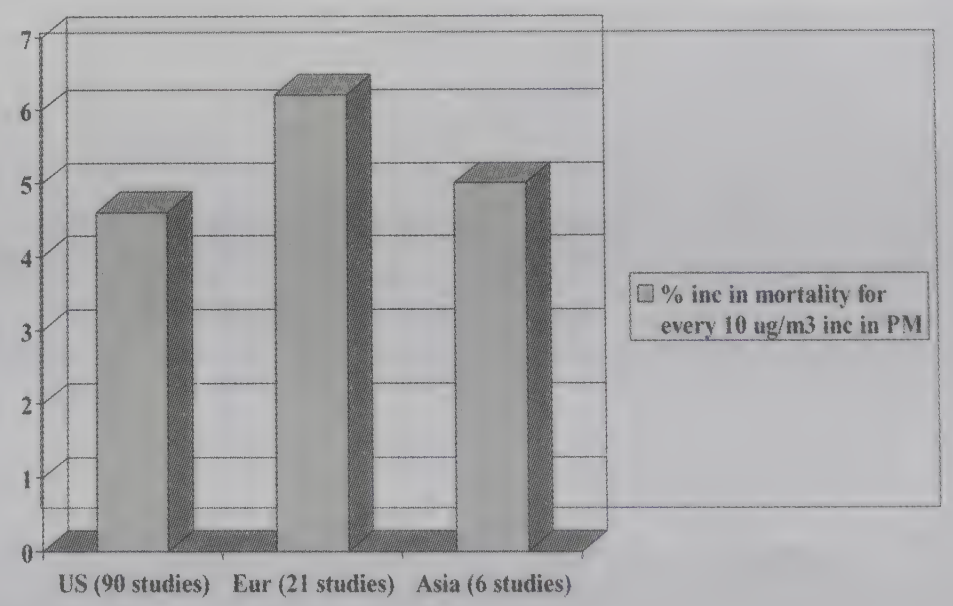
Lung function impairment in residents of Delhi (Non-smokers)



Lung function impairment in children of Kolkata & Delhi



Pm10 rise versus mortality rates in asia



Impact of Air Pollution on Human Health

- **Prevalence of Respiratory Diseases and Ambient Air SPM**

Annual Av. Occurrence of Respiratory Diseases

Ambient SPM Cases/1000 Exposed Population

µg/m³	ICI Kanpur	CCI Bokajan	IOC Haldia	IOC Barauni
Upto 300	23	32	36	26
400-500	43	66	88	49
600-700	98	166	106	84

- **Prevalence of Eye/Skin Symptoms & Ambient Air SPM**

Annual Av. Ambient SPM µg/m3	Eye Symptoms Cases/1000 pop. ICI Kanpur	Eye Symptoms CCI Bokajan	Skin Symptoms Cases/1000 pop. ICI Kanpur	Skin Symptoms CCI Bokajan
upto 300	45	38	5	14
400-500	103	82	19	16
600-700	412	125	58	60

Based on Data Collected by Envirotech's field teams

No.of Cases Per 1000 Population Govt. Hospital Data

Sl. No.	Name of the Diseases	Delhi	Calcutta	India
1	ARI	[illegible]	DNA	10.78
2	Pneumonia	7.17	DNA	0.73
3	Whooping Cough	0.27	DNA	0.21
4	Tuberculosis	12.90	10.73	1.52
5	Diarrhoeal	77.19	4.68	15.56
6	Eye diseases	DNA	0.38	DNA
7	Enteric Fever	1.38	DNA	0.47
8	Hepatitis	0.01	1.62	0.20
9	Cholera	0.05	0.02	0.007
10	Kalazar	[illegible]	0.47	0.07
11	Malaria	0.25	5.09	2.94
12	Encephalitis	nf	DNA	0.009
13	Measels	0.81	0.03	0.23
14	Tetanus	0.[illegible]	0.33	0.04
15	Diphtheria	0.10	1.03	0.02
16	Rabies	0.04	0.02	0.01
17	Syphilis	0.15	DNA	0.11
18	Meningitis	0.31	0.63	0.05
19	Mental Disorder	-	DNA	0.07
20	Poliomyelitis	0.03	DNA	0.02
21	Leprosy	0.02	4.14	1.77

Conclusions

- Standards have helped in deciding category of the area
- Since health problems in urban area are in rising trend air quality standards have not been able to reduce the heath risks
- The only positive role standards could play that they have attracted enough attentions towards non-attainment areas due to visible acute health problems.
- Hope effective implementations of management and control strategies shall be done in such areas to improve air quality in-order to mitigate air pollution related health risks.

Proposed National Ambient Air Quality Standards (NAAQS)

S. No.		General Area			
	Averaging Period	1-hour	8-hour	24-hour	Annual
	Parameter				
1.	Benzene (C_6H_6)	-	-	15µg m³	5µg m³
2.	Carbon Monoxide (CO)	400µg m³	2000µg m³		
3.	Formaldehyde	80µg m³	40µg m³	-	-
4.	Polycyclic Aromatic Hydrocarbons (BaP) (particulate only)	-	-	5ng m³	1ng m³
5.	Arsenic	-	-	20ng m³	6ng m³
6	Lead	-	-	1µg m³	0.5µg m³
7	Mercury (1)	-	-	-	-
	Total Mercury	-	-	15ng m³	-
	Particulate Mercury	-	-	3ng m³	-
	Vapour Mercury	-	-	12ng m³	-
8	Nickel	-	-	25 ng m³	-
9	Vanadium	-	-	200ng m³	-
10	Nitrogen dioxide (NO_2)	200 µg m³	-	80.0 µg m³	40.0 µg/m³ 30.0 µg/m³

S. No.		General Area			
	Averaging Period	1-hour	8-hour	24-hour	Annual
	Parameter				
11.	Ozone	180μg/m³	90μg/m³	-	-
12.	Particulate Matter (PM10)	-	-	100μg/m³	60μg/m³
	Particulate Matter (PM2.5)	-	-	60μg/m³	40μg/m³
13.	BSF TSF (Benzene/toluene soluble fraction)	-	-	20μg/m³	-
14.	Sulphur dioxide³ (SO_2)	260 μg/m³	-	80 μg/m³	50 μg/m³ 20 μg/m³
15.	Ammonia	-	-	400 μg/m³	100 μg/m³

REASONS FOR HIGH AIR POLLUTION IN INDIA

- QUALITY OF FUEL (COAL, DIESEL, PETROL, FUEL OIL)
- TOXIC AND HAZARDOUS AIR POLLUTION EMISSION FROM CHEMICAL INDUSTRIES
- PROCESS TECHNOLOGY (SPECIALLY IN S.S.I.)
- SITING OF INDUSTRIES SPECIALLY INDUSTRIAL ESTATES
- NO POLLUTION PREVENTIVE STEP TAKEN (EARLY STAGE OF INDUSTRIALISATION)
- PREDOMINANCE OF 2-STROKE VEHICLES
- UNCONTROLLED GROWTH OF VEHICLE POPULATION
- INADEQUATE POLLUTION PREVENTION AND CONTROL SYSTEM IN SMALL/ MEDIUM SCALE INDUSTRY (S.M.S)
- POOR COMPLIANCE OF STANDARD IN S.M.S.

Proposed Air Quality Standards

(1) Whenever measurement of vapour mercury is difficult, standard for particulate mercury will not be applicable.

(2) For NO_2, in case of general areas annual average standard of 40 μg/m³ and in case of sensitive/protected areas seasonal (three months) average standard of 30 μg/m³ shall be applicable.

(3) For SO_2 in case of general areas annual average standard of 50 μg/m³ and case of sensitive/protected areas seasonal (three months) average standard of 20 μg/m³ shall be applicable.

Morbidity Rates Based on ESI Hospital

Sl. No.	Diseases	1996
1	Tuberculosis	18.2
2	Bronchitis	204.8
3	Other Respiratory Diseases	60.2
4	Influenza	168.8
5	Acute Nasopharyngitis (commoncold)	227.2
6	Acute Pharyngitis & Tonsillitis	68.8
7	Diarrhoea & Enteritis	144.4
8	Dysentry all forms	282.8
9	Other disease of digestive system	107.5
10	Skin Infection	129.4
11	Other diseases of the skin	75.4
12	Allergic disorders	92.5
13	Diseases of Eye	94.1
14	Cholera Enteric Fever and other intestinal Tract disease	21.8
15	Malaria	23.2
16	Vitamin Defficiency	105.6
17	Diseases of ear & Mastoid Process	46.8
18	Anaemias	82.0
19	Other Parasic & Infection	43.5
20	Arthiritis & Rheumatism	94.6
21	Accidents Poisoning & Violence	160.7

Prevalence of some common diseases w.r.t. Ambient SPM based on ENVIROTECH Health Survey around Industries

A : Around a cement plant - Assam

Sl. No.	Ambient SPM (ug/m^3)	Prevalence No. of cases / 1000 population Examined					
		Bronchitis	Tonsilitis	Sinusitis	Asthma	Dermatosis	Conjunctivitis
1	Above 600	107	28	116	5	60	125
2	300 - 600	36	10	10	10	16	82
3	Below 300	32	6	22	4	14	58

B : Around an Oil Refinery - West Bengal

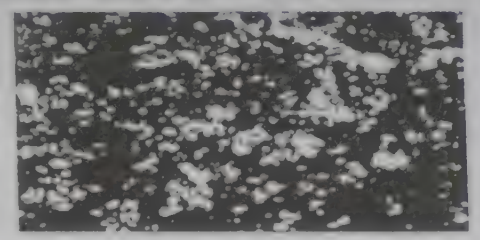
Sl. No.	Ambient SPM (ug/m^3)	No. Cases Examined	Prevalence No. of cases / 1000 population of Respiratory diseases	
			ARI	COPD
1	Above 300	834	108	164
2	200 - 300	349	89	158
3	Below 200	352	26	116

C : Around an Oil Refinery - Bihar

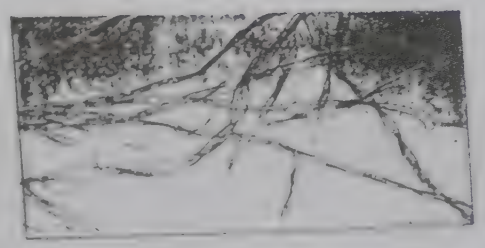
Sl. No.	Ambient SPM (ug/m^3)	No. of Cases Examined	Cases with Respiratory Problems	Prevalence No. of cases per 1000 population
1	Above 400	634	27	43
2	250 - 300	586	15	26
3	Below 250	288	5	17

D : Around a Fertiliser Plant - Uttar Pradesh

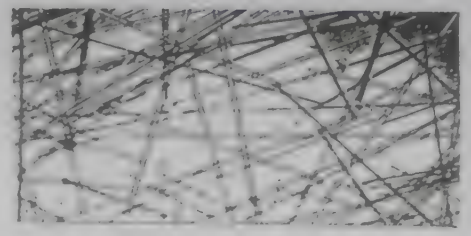
Sl. No.	Ambient SPM (ug/m^3)	Prevalence No. of cases / 1000 population examined		
		Eye symptom	Respiratory problem	Skin disorders
1	300 - 600	412	43	58
2	Below 300	45	25	5



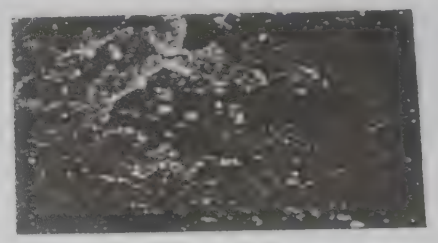
PARTICULATE MATTER NEAR TO CEMENTPLANT IN M.P. (MAG. 100X)



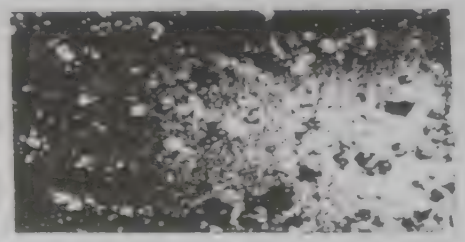
PARTICULATE MATTER NEAR COTTON MILL IN U.P (MAG. 100 X)



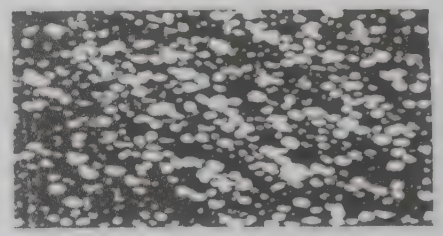
PARTICULATE MATTER NEAR FACTORY IN BIHAR (MAG.100X)



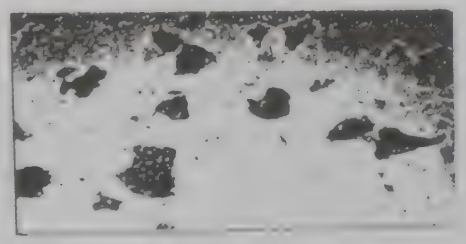
PARTICULATE MATTER IN RURAL AREA (MAG. 100X)



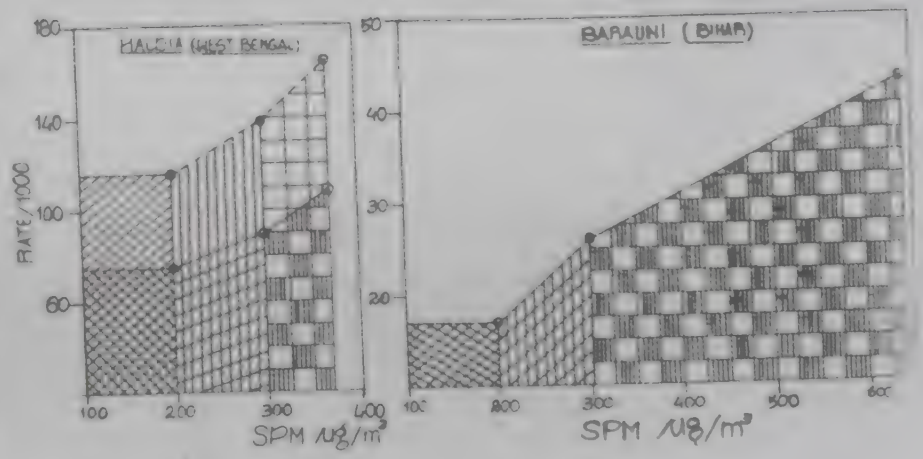
PARTICULATE MATTER NEAR THERMAL POWER STATION IN BIHAR (MAG. 100X)



PARTICULATE MATTER IN A REFINERY AREA (MAG. 100X)



PARTICULATE MATTER NEAR [illegible] (MAG. 100X)



Causes Of Deaths

Sl. No.	Major Cause	1982	1985	1984	1985	1986	1987
1	Accidents & Injuries	953	950	1069	1080	1269	1511
2	Child Birth & Pregnancy	168	208	176	206	176	197
3	Fevers	1507	1757	1613	1609	1894	1898
4	Digestive Disorders	1170	1266	1303	1305	1410	1459
5	Disorder of the Central Nervous System	594	771	679	723	684	795
6	Coughs (Disorder of Respiratory system)	3183	3472	2598	3581	3603	4053
7	Diseases of Circulatory system	1426	1575	1695	1705	1649	1955
8	Sullity	5854	5986	5945	5723	4090	4659
9	Other Clear Symptoms	1296	1281	1580	1555	1581	1880
10	Causes of peculiar infancy	1887	1898	1948	1772	19925	2058
11	The rest	305	51	92	-	-	-
		16145	17211	17679	17258	18262	20241

Source : Survey of causes of Deaths. Annual Report 1986 Serial 3 No. 14, Table No. - 3.

Reason For High Pollution In Cities

- Emission loads of pollutants are high due large number of vehicles . Poor Quality of roads´.Fuel adulteration.Dust on roads.Tyre Attrition.

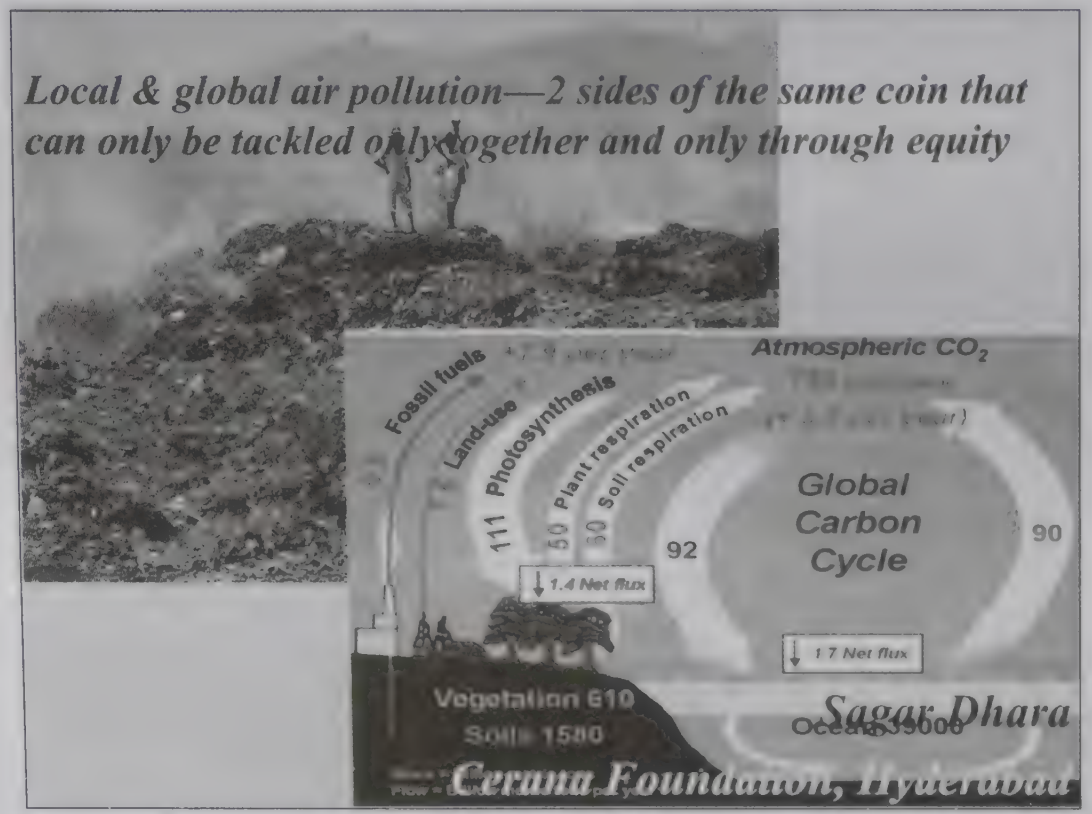
Hospital Registered Cases Per 1000

Sl. No.	Disease	West Bengal	Bihar
1	Disease of Respiratory System	195.48	126.06
2	Infective & Parasitic Diseases	150.49	160.75
3	Diseases of Digestive system	145.28	79.52
4	Diseases of Nervous system and sense organs	108.88	55.84
5	Disease of Blood and blood forming organs	101.63	49.91
6	Disease of skin and subcutaneous tissues	54.07	35.53
7	Endocrine Nutritional Metabolic Immunity	42.35	51.61
8	Ill defined conditions	31.92	12.69
9	Disease of Circulatory system	28.66	19.46
10	Disease of musculo - skeletal system and connective tissue	28.01	31.30
11	Disease of Genito - urinary system	9.12	16.07
12	Congenital anomalies	5.21	2.54
13	Mental Disorders	4.56	6.72
14	Injury and poisoning	4.56	8.46
15	Neoplasms	0.65	6.77
16	Certain conditions originality in natal period	-	5.07

Air Quality Status of India During 2003

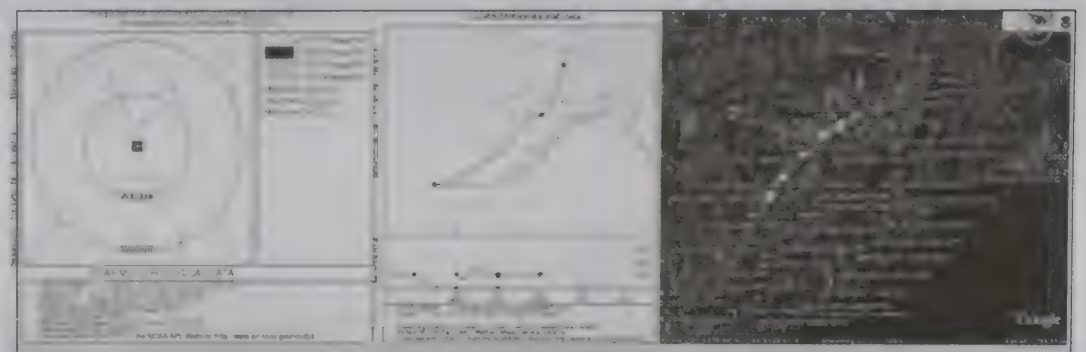
Pollutants	Industrial				Residential			
	L	M	H	C	L	M	H	C
Sulphur dioxide	98 %	2 %	-	-	98 %	2%	-	-
Nitrogen dioxide	85 %	12%	3%	-	70%	25%	5%	-
Respirable Suspended Particulate Matter	13 %	37%	28 %	22 %	2%	17%	28%	53%
Suspended Particulate Matter	31%	46%	18 %	2%	5%	17%	26%	52%

Mr Sagar Dhara, *Cerana Foundation,* Local & global air pollution:
Two sides of the same coin that can only be tackled together and through equity in carbon emissions.

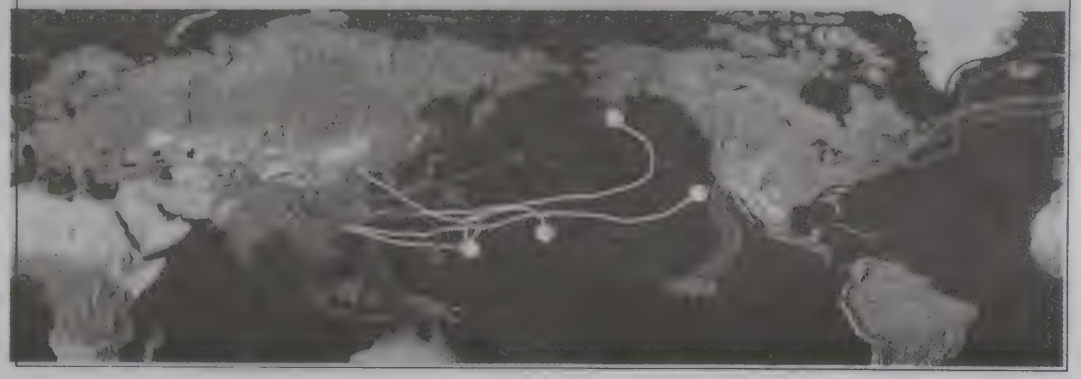


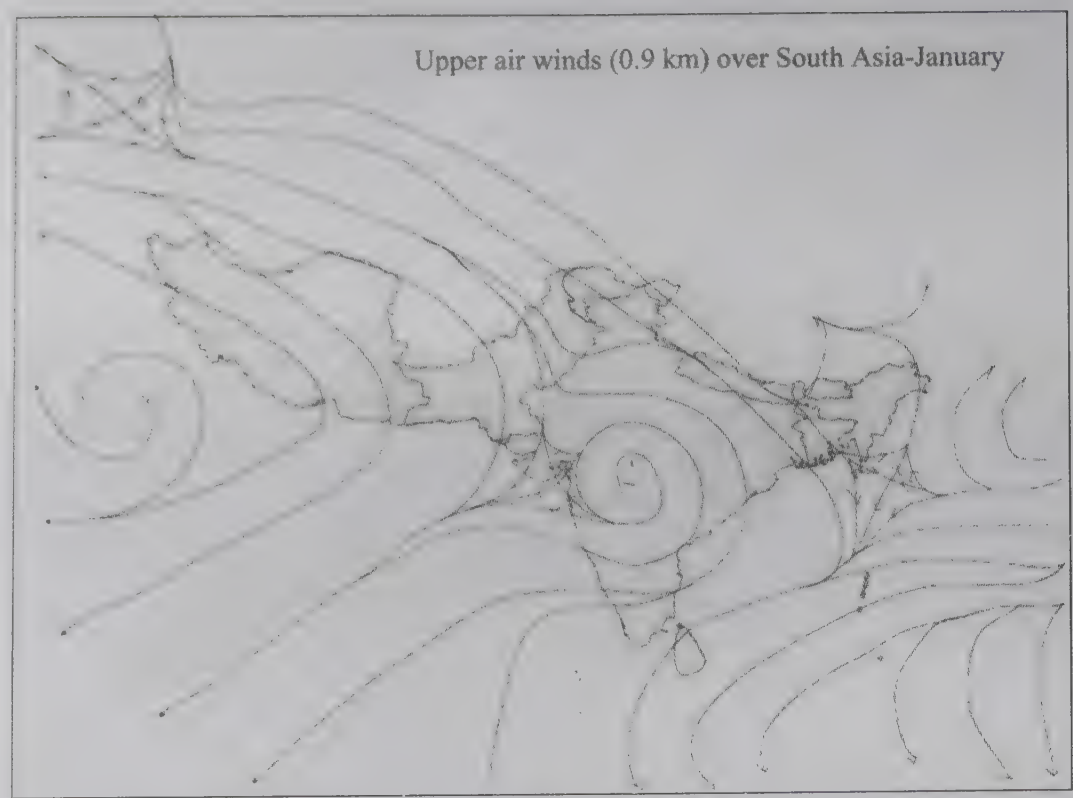
Air pollution, the biggest risk that human society has faced to date

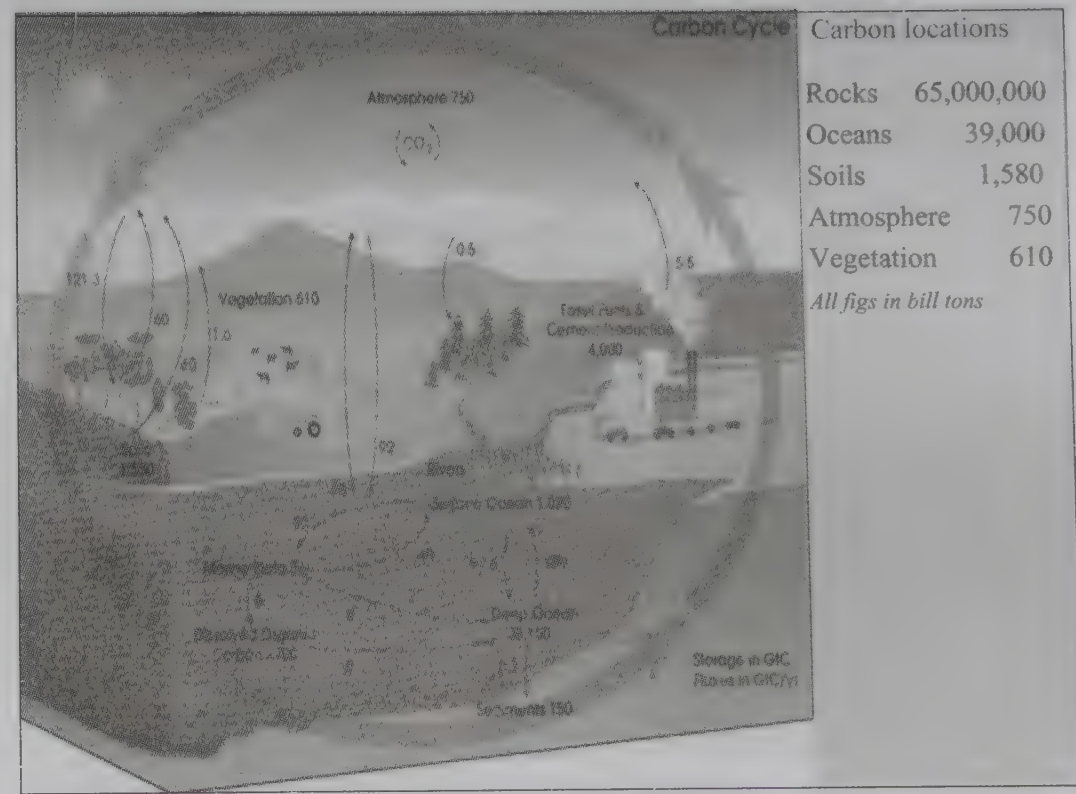
- Local—indoor, shopfloor and ambient
- Regional—transboundary air pollution
- Global—CO_2 concentration buildups

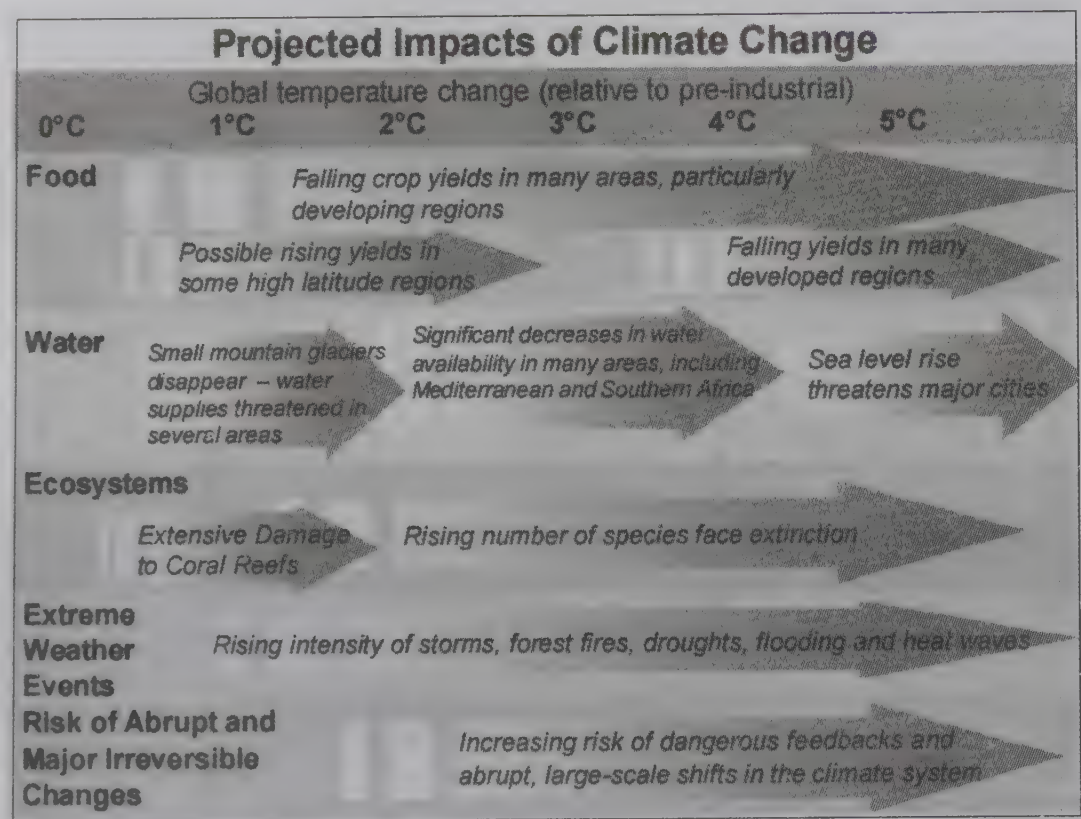


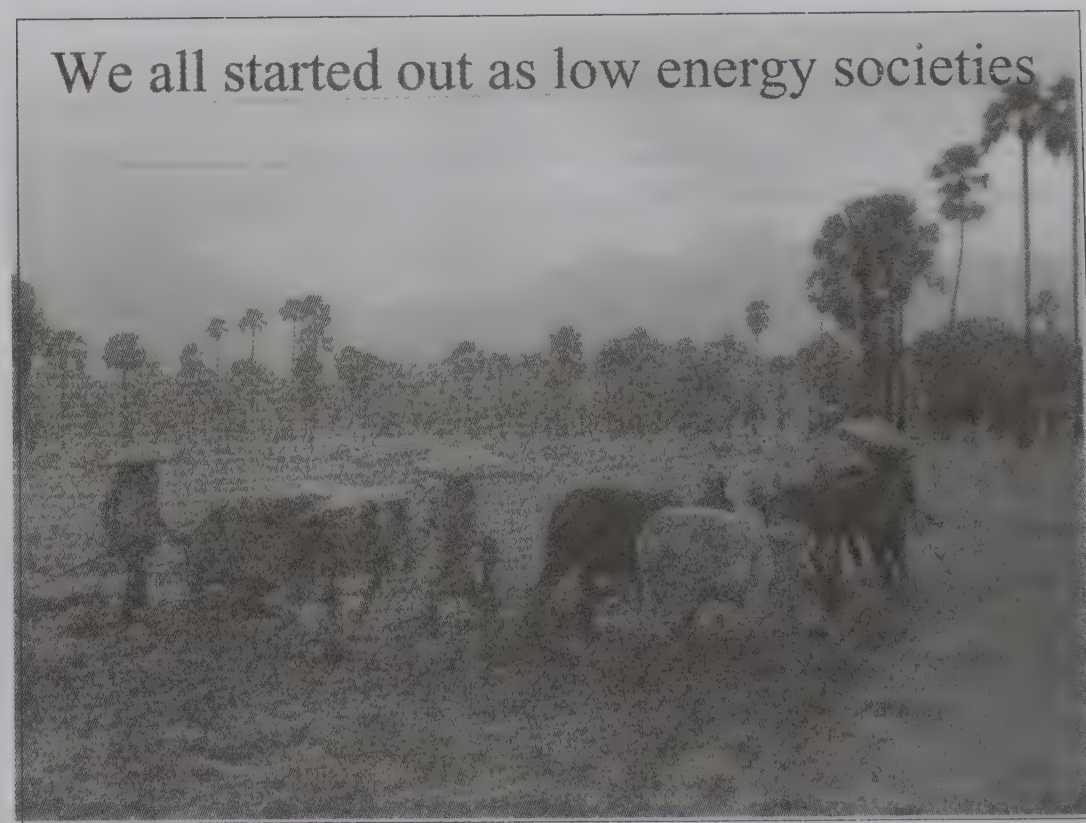
Regional transport of air pollution

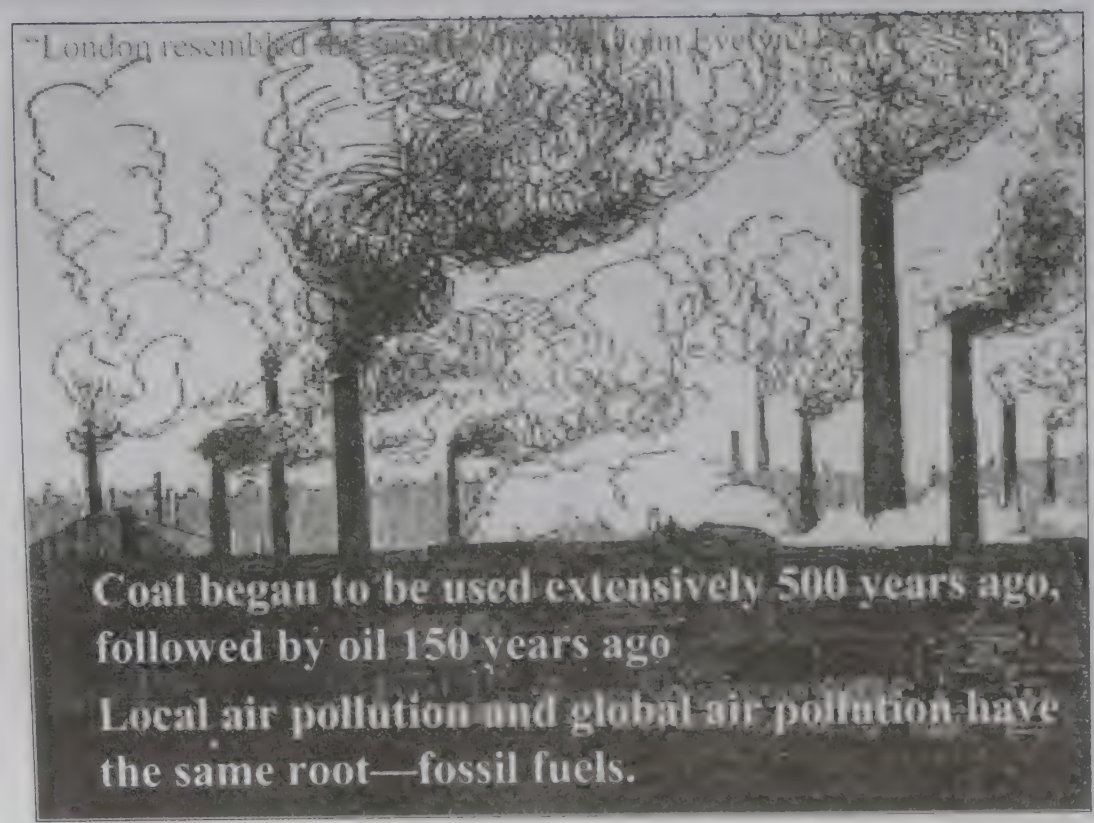



Upper air winds (0.9 km) over South Asia-January

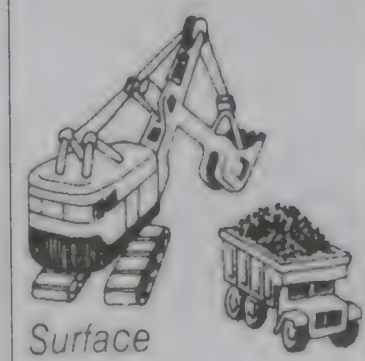

Carbon Cycle
Atmosphere 750
Vegetation 610
Rocks 65,000,000
Oceans 39,000
Soils 1,580
Atmosphere 750
Vegetation 610
All figs in bill tons

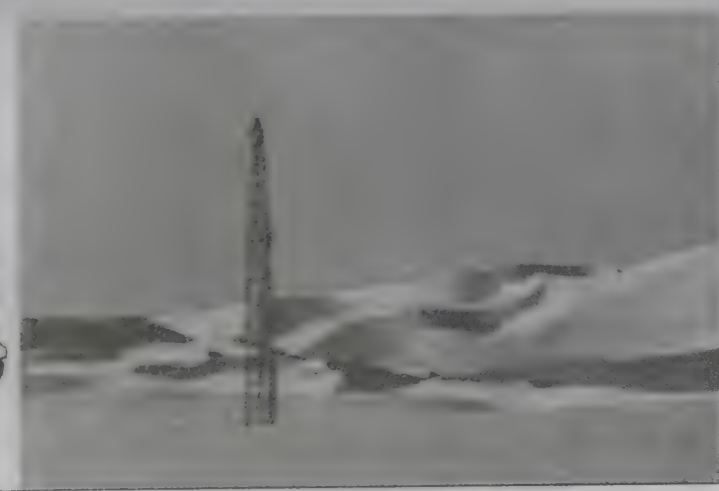

Projected Impacts of Climate Change
Global temperature change (relative to pre-industrial)
0°C
1°C
2°C
3°C
4°C
5°C
Food
Falling crop yields in many areas, particularly developing regions
Possible rising yields in some high latitude regions
Falling yields in many developed regions
Water
Small mountain glaciers disappear – water supplies threatened in several areas
Significant decreases in water availability in many areas, including Mediterranean and Southern Africa
Sea level rise threatens major cities
Ecosystems
Extensive Damage to Coral Reefs
Rising number of species face extinction
Extreme Weather Events
Rising intensity of storms, forest fires, droughts, flooding and heat waves
Risk of Abrupt and Major Irreversible Changes
Increasing risk of dangerous feedbacks and abrupt, large-scale shifts in the climate system

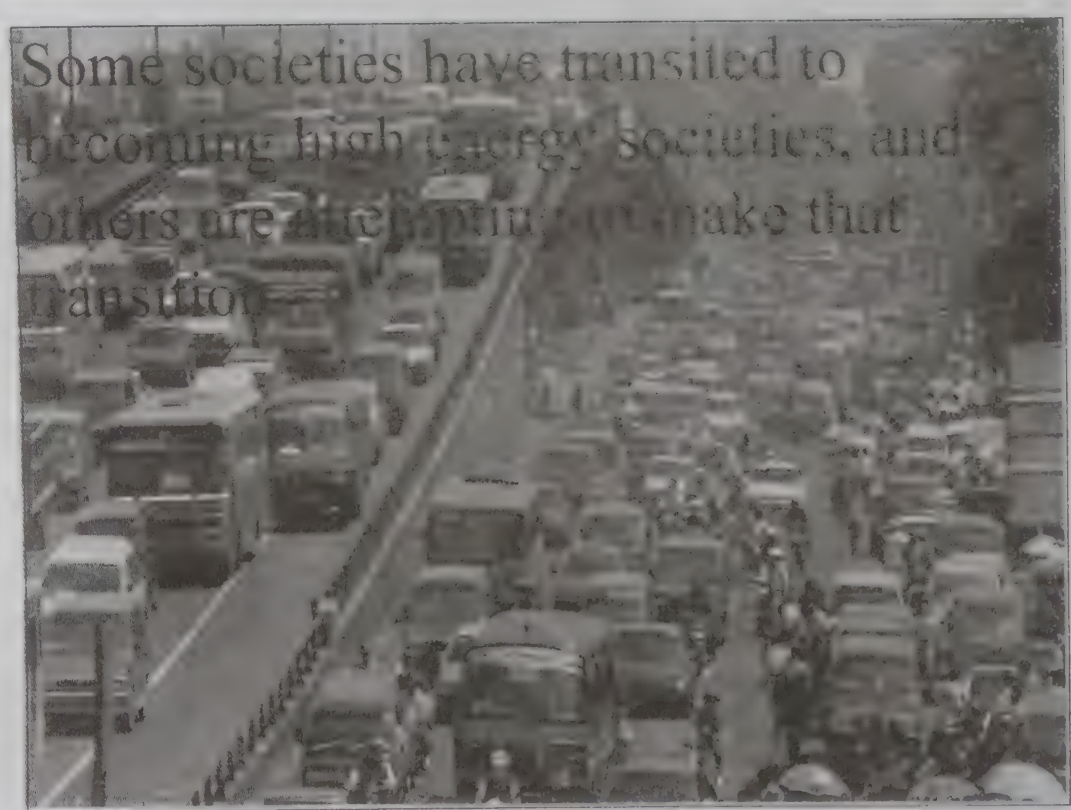

We all started out as low energy societies

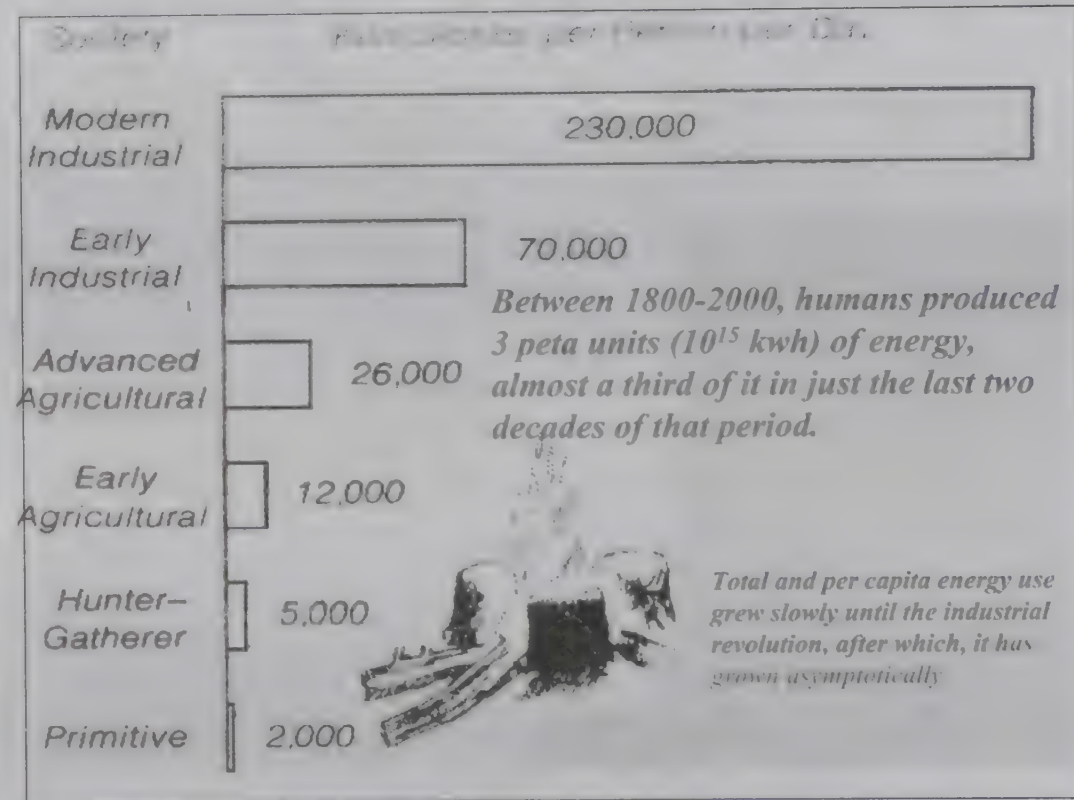


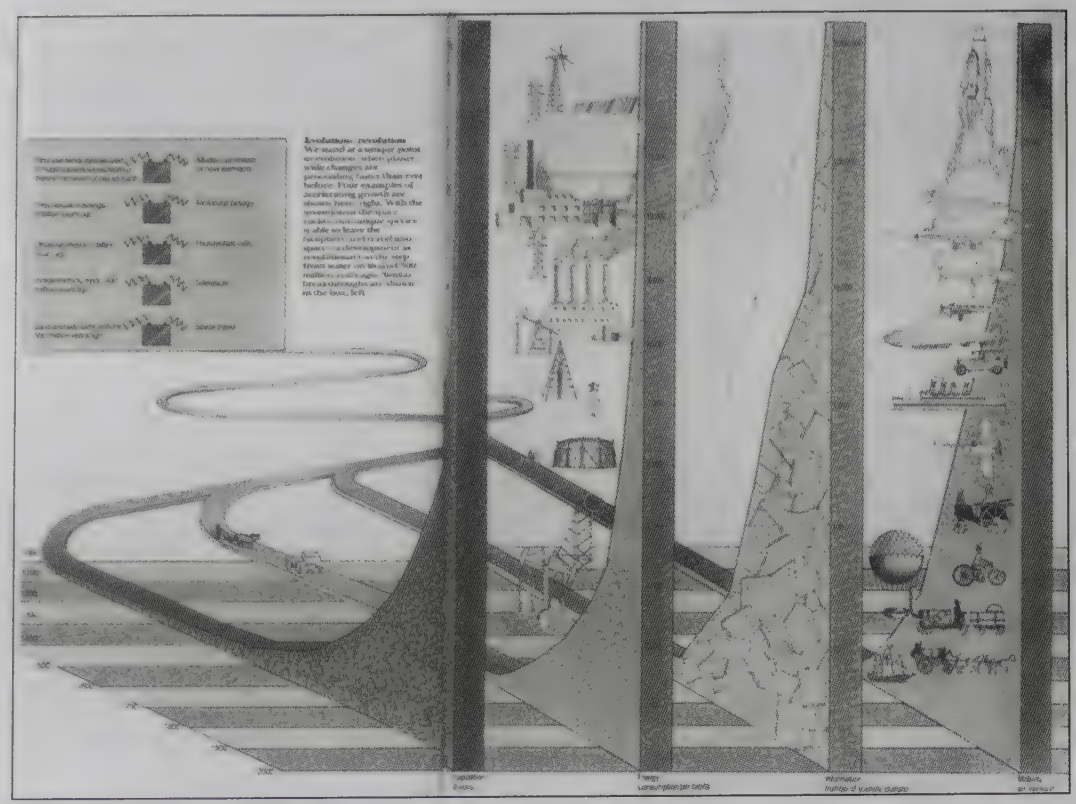
- 19th Century … coal
- 20th Century … oil

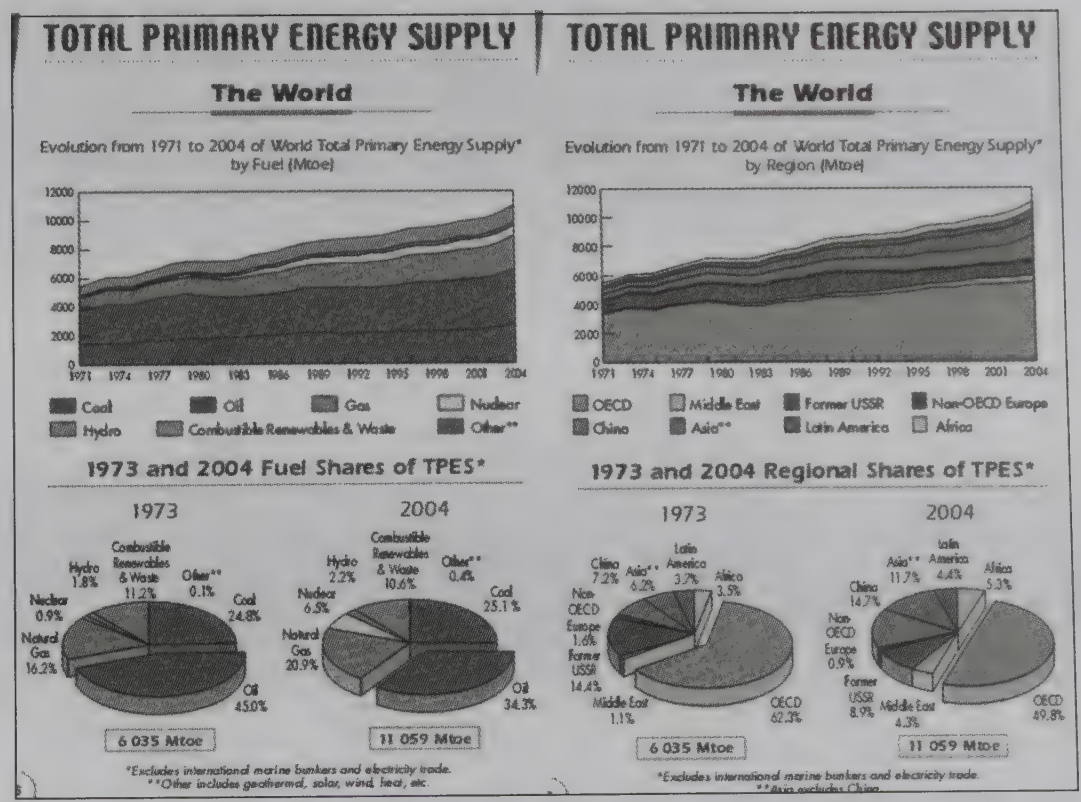




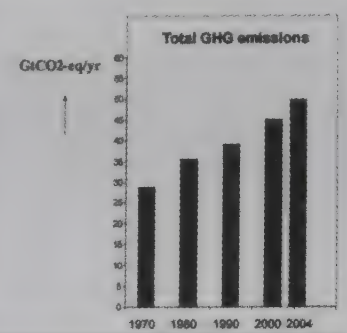






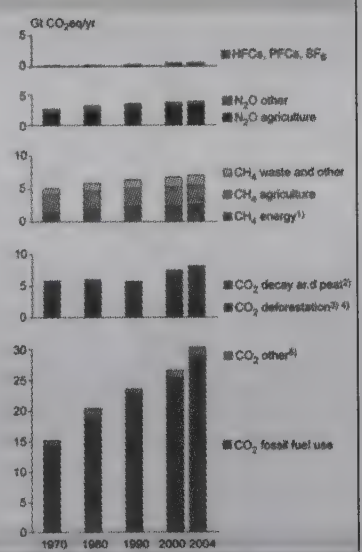


Between 1970 and 2004 global greenhouse gas emissions have increased by 70 %

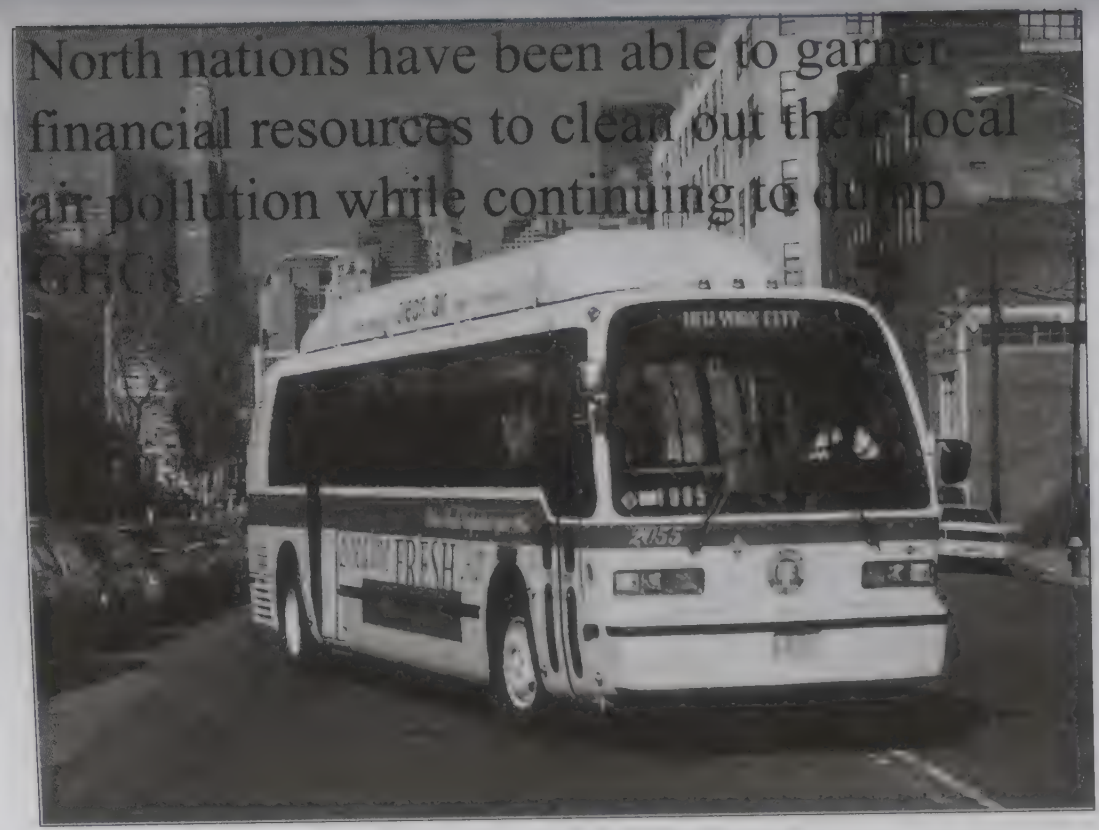


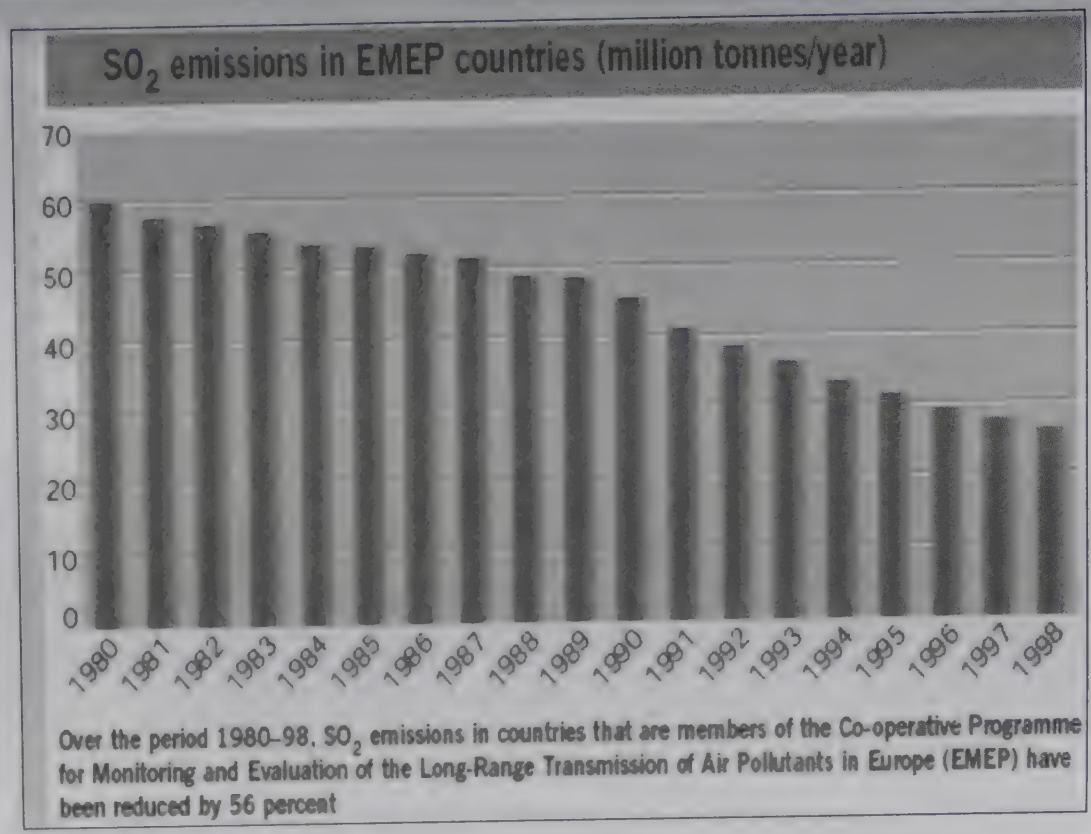
- Annual fossil CO_2 emissions increased from an average of GtC per year in the 1990s, to GtC per year in 2000-2005

Carbon dioxide is the largest contributor

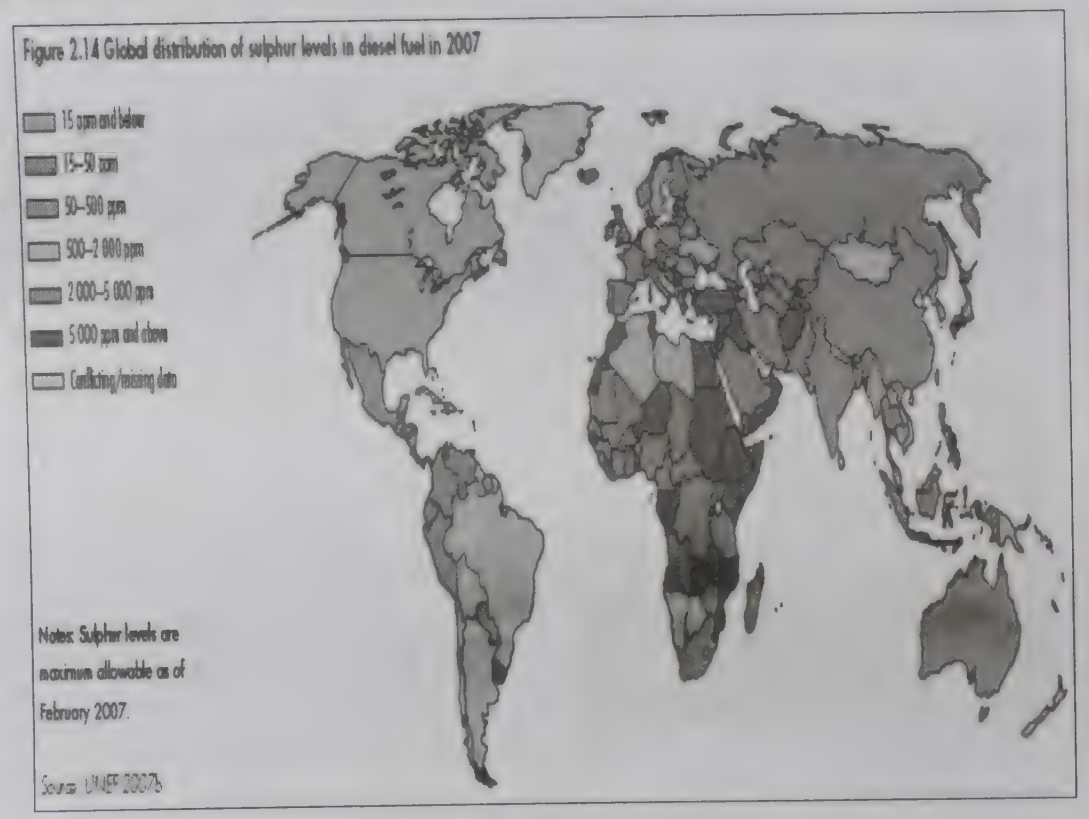


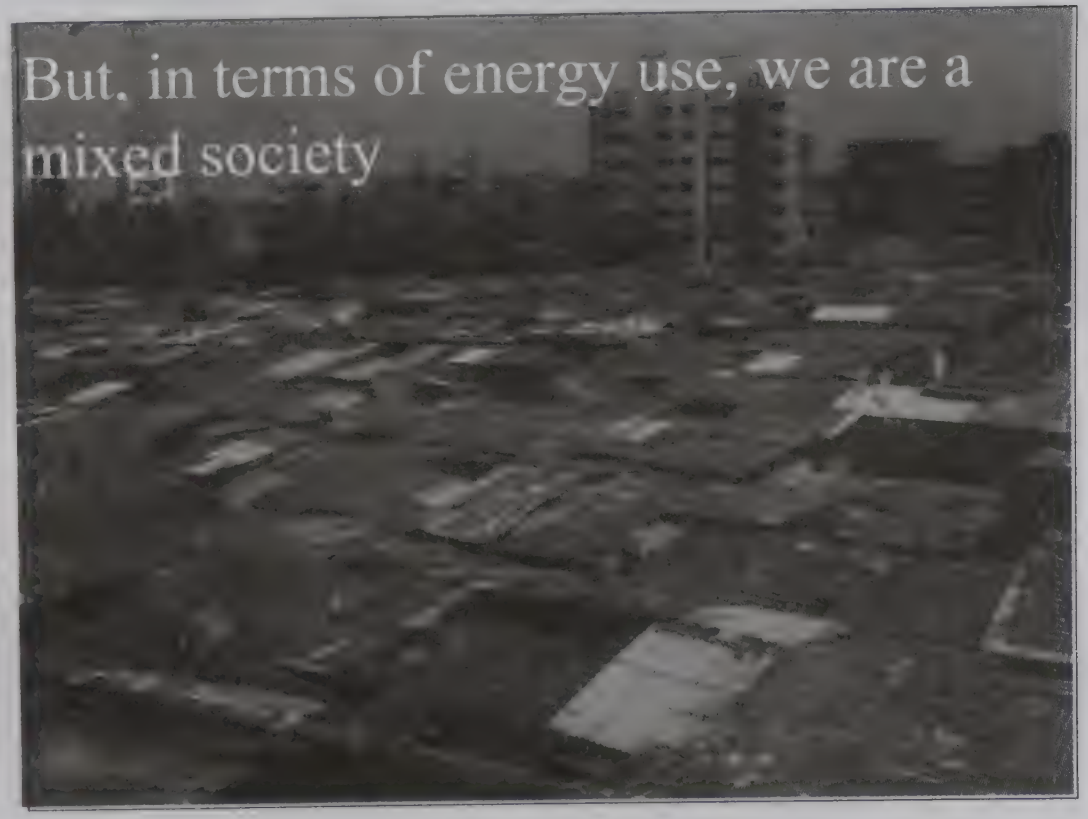
- Global SO_2 emissions—56% from coal, 24% oil, 15% industrial processes, 3% biomass burning





Over the period 1980–98, SO_2 emissions in countries that are members of the Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) have been reduced by 56 percent





To reduce air pollution related health risks in a high energy society requires:

- Fuel quality improvement
- Transport technology shifts
- Habitat re-design

What does this cost?

- Fuel quality shift — possible
- Transport technology shift — iffy
- Habitat re-design @Rs 1000 cr/km^2 — Source?

Lung function impairment in residents of Delhi (Non-smokers)

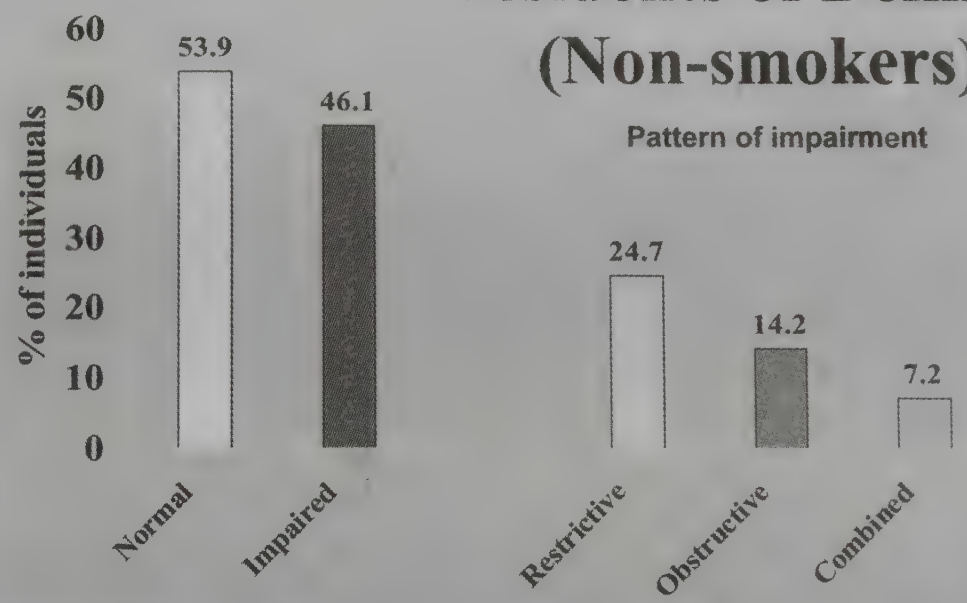
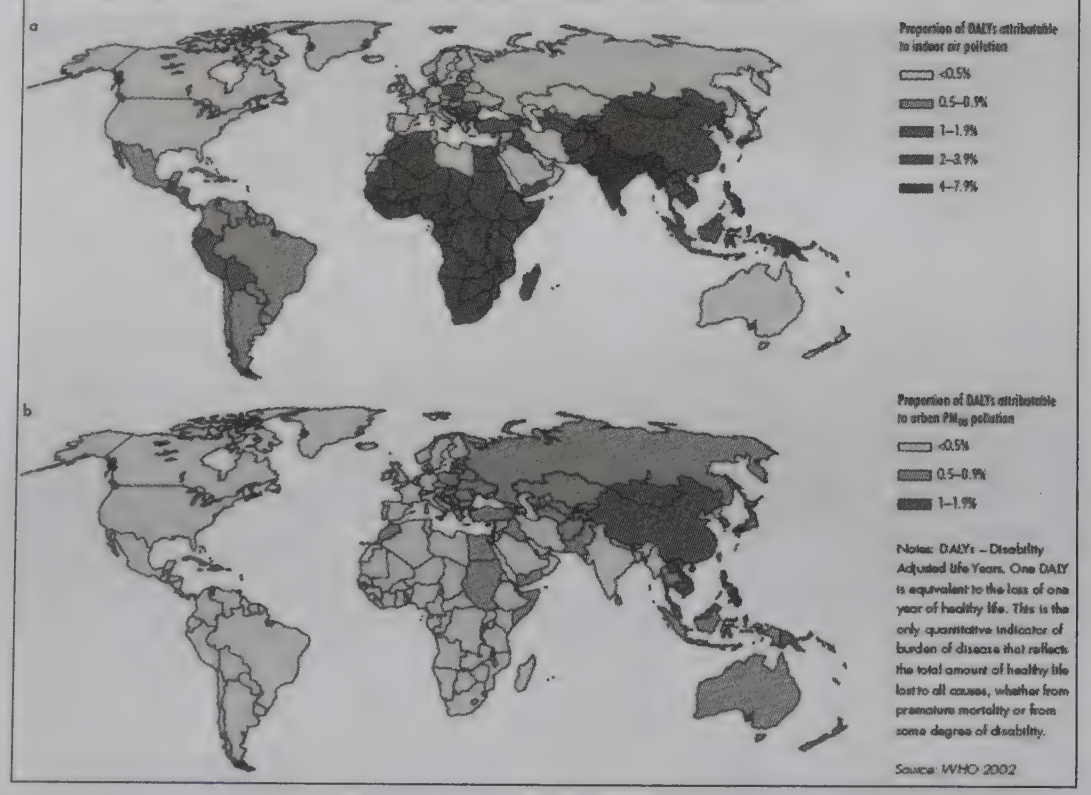
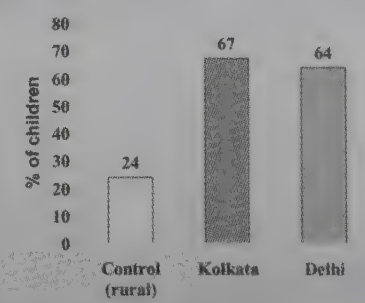


Figure 2.12 Global estimates of disease attributed to (a) indoor and (b) urban PM_{10} pollution, measured in DALY's



Injury guesstimation

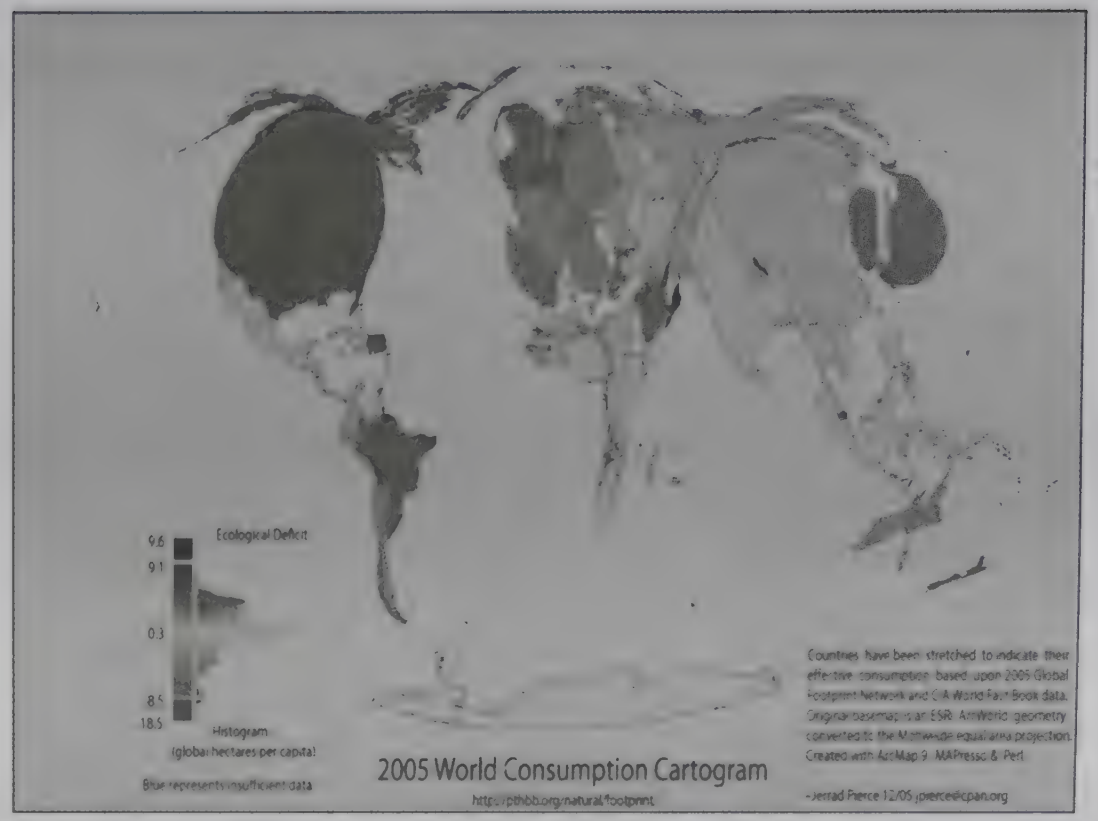
- **Air pollution-related excess mortality and morbidity are estimated to be 100,000-200,000 and 3.5 million per year.** Source: Dhara, The Hindu, Apr 19, 2002
- **A study carried out in 1996 indicated that 373,00 deaths occurred due to indoor air pollution compared to 70,000 due to outdoor air pollution: (5 times higher incidences in indoor air pollution). Source:**
- **Almost half a million children under the age of five die each year from indoor air pollution in India. Source:**
- **More Indians die because of three types of injuries**—workplace accidents, occupational diseases environmental exposures—**than due to all other manner of other man-made violence**—communal and political violence, crimes, etc.
- **Yet, this problem has gone un-noticed and un-addressed.** Workplace injuries are grossly under-reported and environmental injuries remain un-estimated.



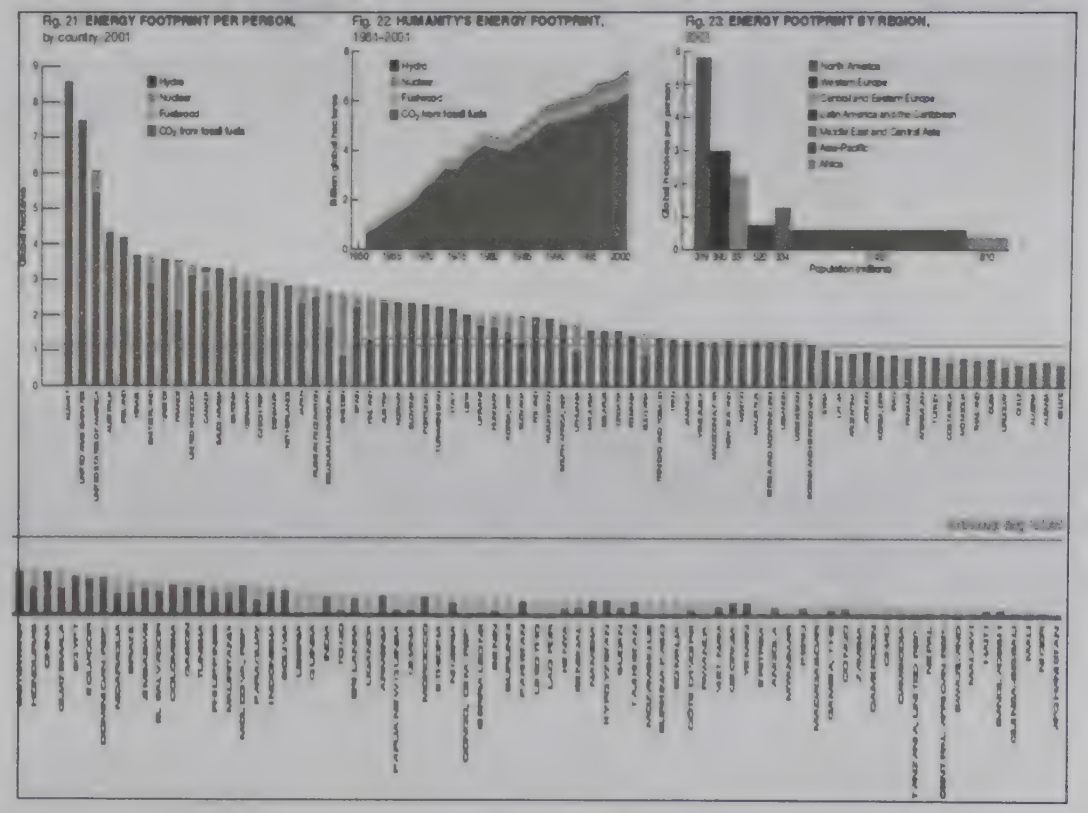
Lung function impairment in children of Kolkata & Delhi

- Problem of local and global air pollution cannot be solved unless the current "air of inequality" transits to "equity to good air"

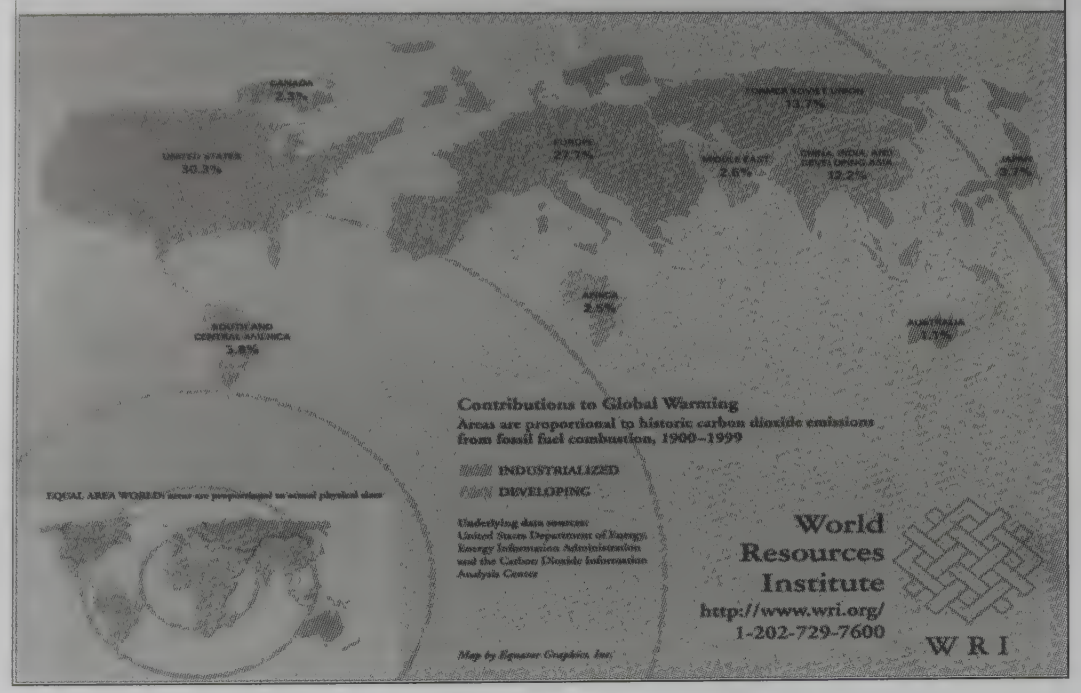
- This perforce means equity in energy resource access and consumption



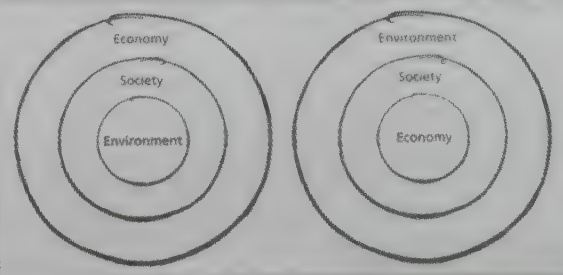
Consumption figs in TOE	1971	1981	1991	1999
Central Africa	0.38	0.39	0.37	0.34
Northern Africa	0.28	0.49	0.65	0.69
Southern Africa	1.23	1.30	1.27	1.18
Australia + New Zealand	3.79	4.47	4.91	5.56
Central Asia	2.70	3.17	3.04	3.43
NW Pacific + East Asia	0.70	0.85	1.10	1.28
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
South East Asia	0.36	0.44	0.58	0.73
Central Europe	1.87	2.30	2.04	1.81
Eastern Europe	3.34	4.55	5.01	3.49
Western Europe	3.03	3.31	3.70	3.86
Caribbean	1.21	1.26	1.06	1.11
Meso America	0.80	1.29	1.28	1.29
South America	0.83	0.97	0.98	1.13
North America	7.41	7.57	7.52	8.08
Arabian Peninsula	1.08	3.31	3.43	3.62
Mashriq	0.48	0.83	0.97	1.23

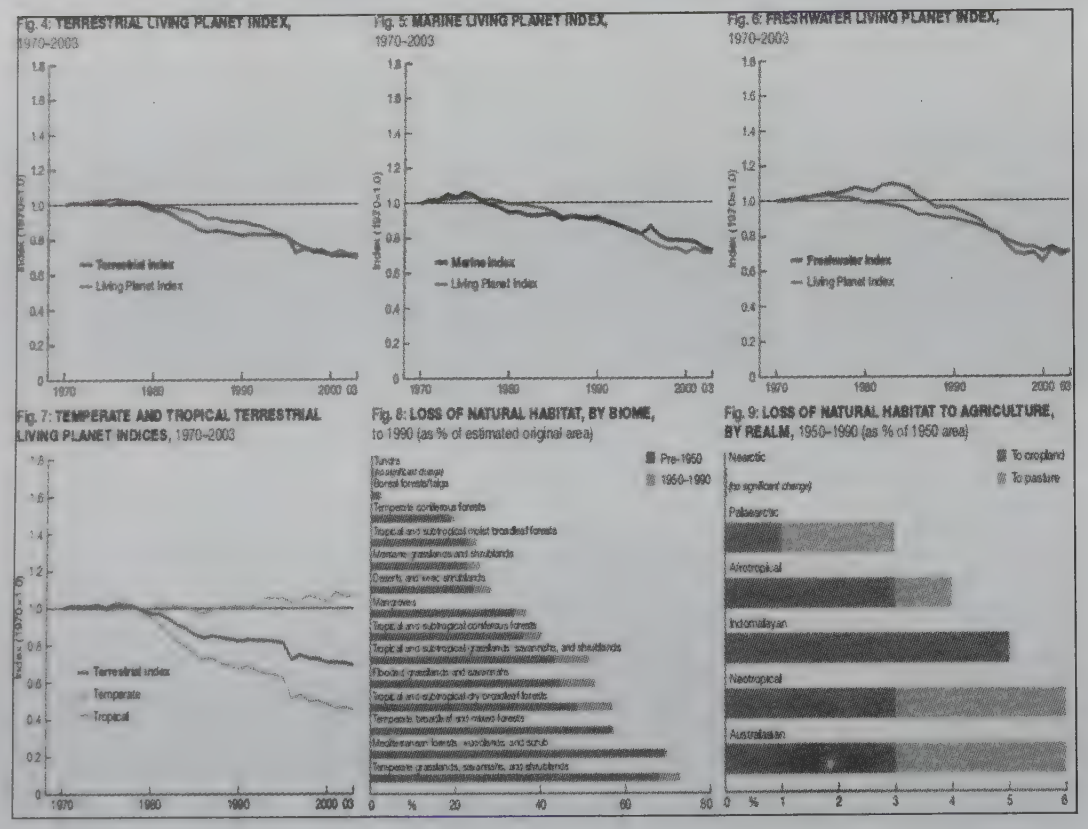


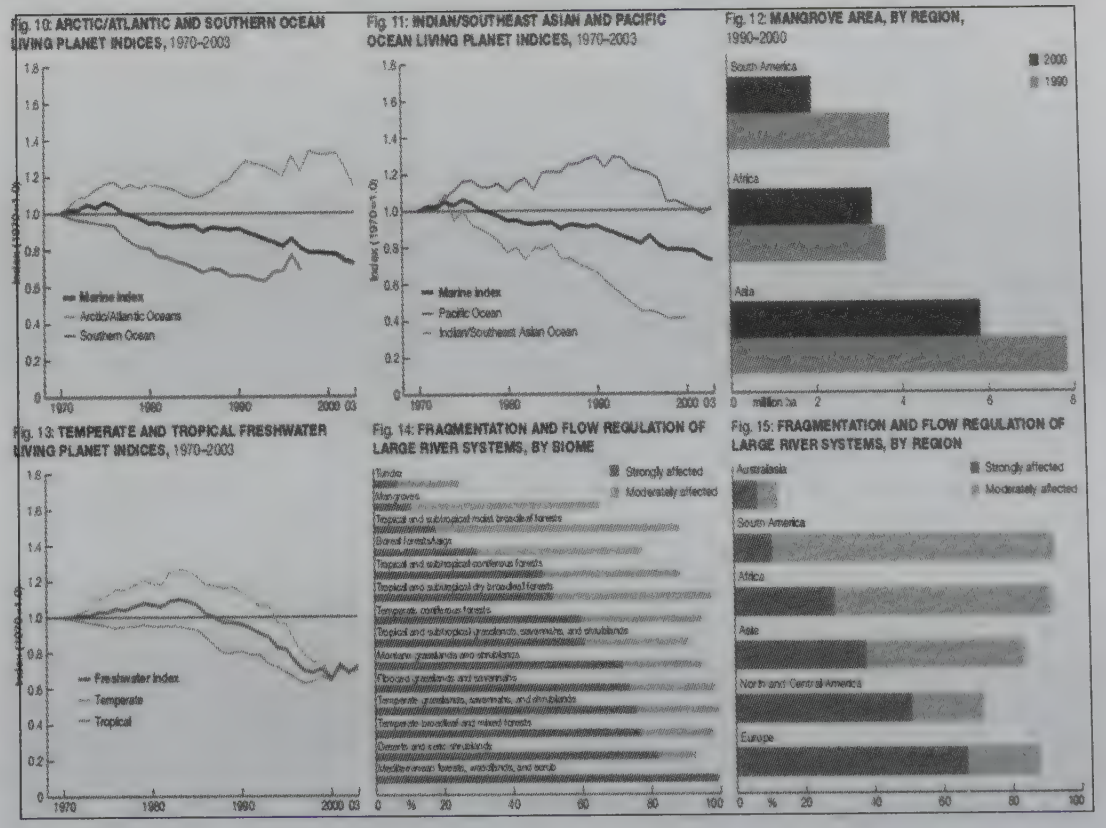
GHG dumping



- And as long as economies are based on greed, sustainable living is just a dream







- Technical, legal, economic fixes are inadequate
- More people who apply their minds to this the better
- Need for innovative thinking

Air quality management

Public participation	52
Planning of air quality management	49
Emission control	38
Technology interventions	21
Transport sector	7

Asthma management

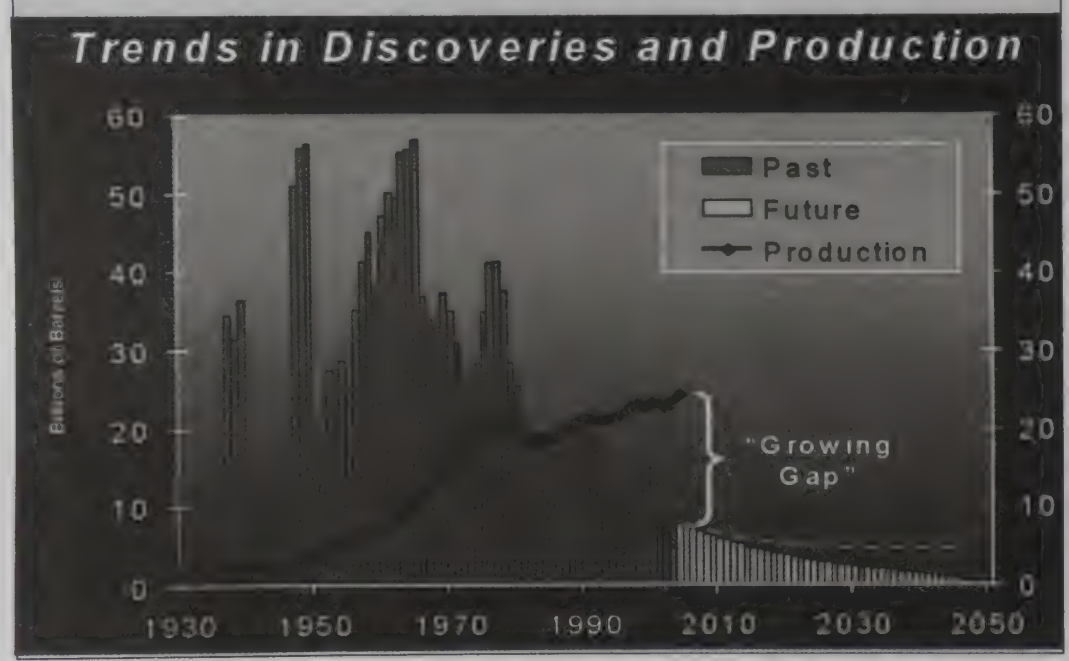
Education and management	29
Networking	21
Asthma surveillance	19
Resource bank	16
Research	16
Education through media	9
Advocacy	7

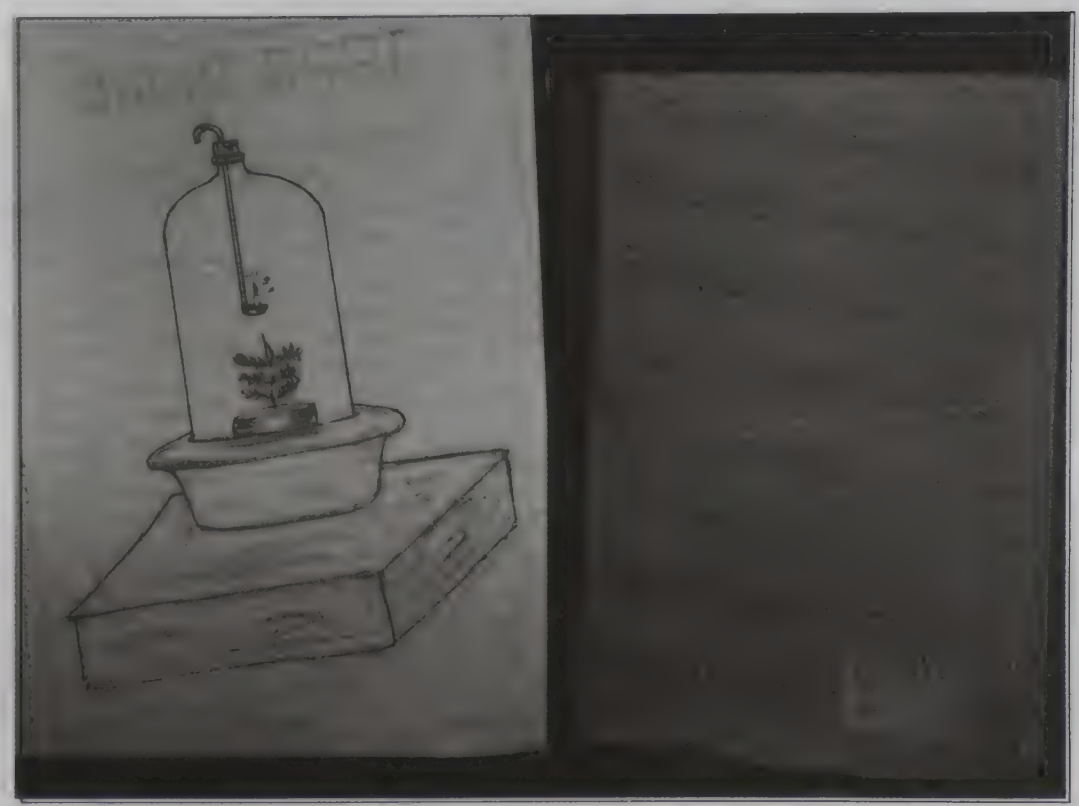
Community interventions

Education and awareness	37.5
Collective action	24.5
Government accountability	24.5
Changing value systems	8.5

- **Conclusion:** For tackling these issues, participants voted higher for making interventions through people rather than through technology

Oil discovery peaked in 1962. Current consumption is 6 barrels for every barrel discovered.



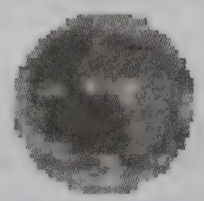


Solution!

Living on One World

The LOW footprint challenge

"quality living on one world"



Living as if we had Three Planets

If everyone in the world, lived like the average European we would need:

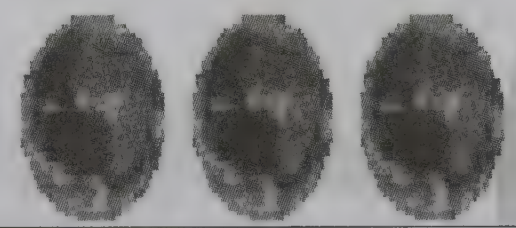
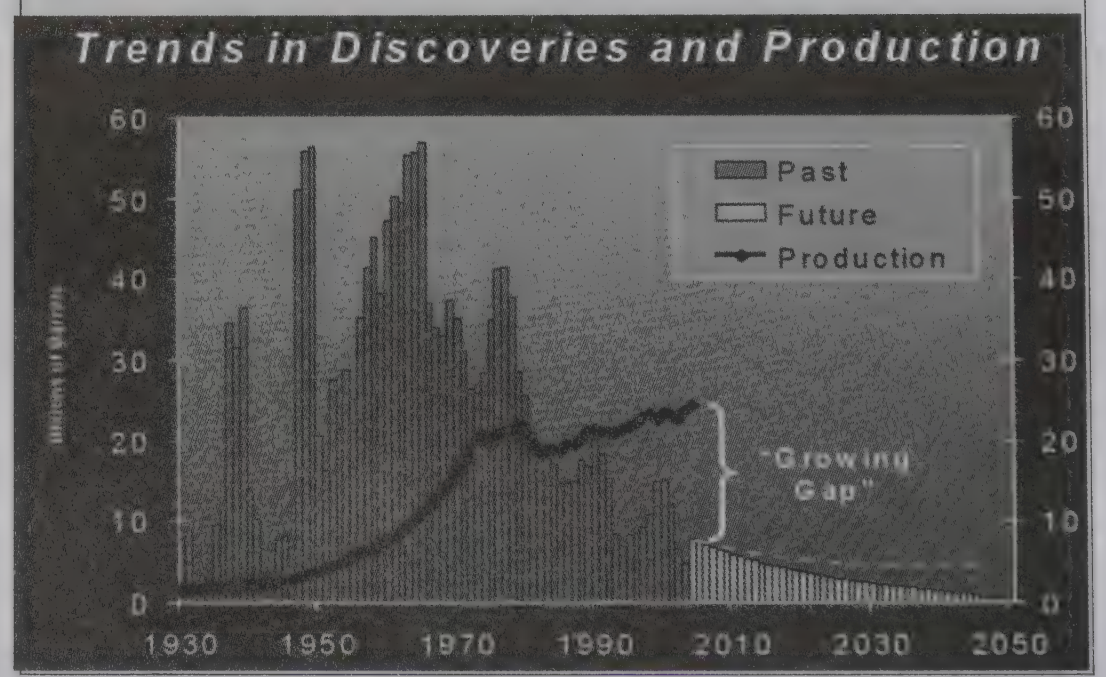
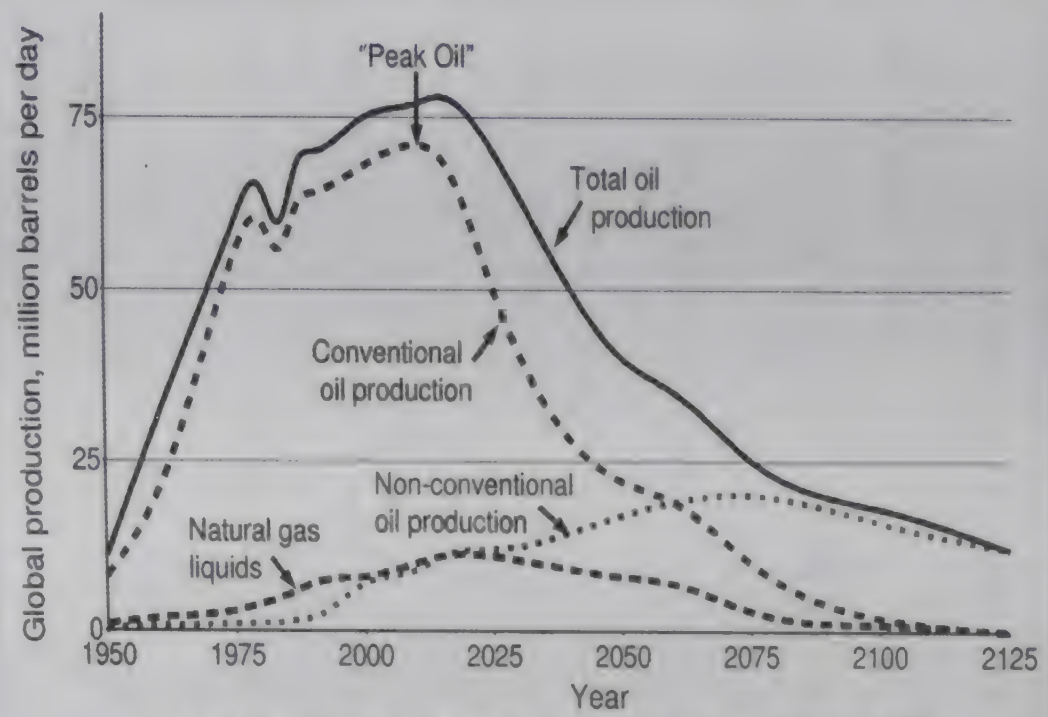


Figure 2.6 Amount of space required to transport the same number of passengers by car, bus or bicycle. (Poster in city of Muenster Planning Office, August 2001)

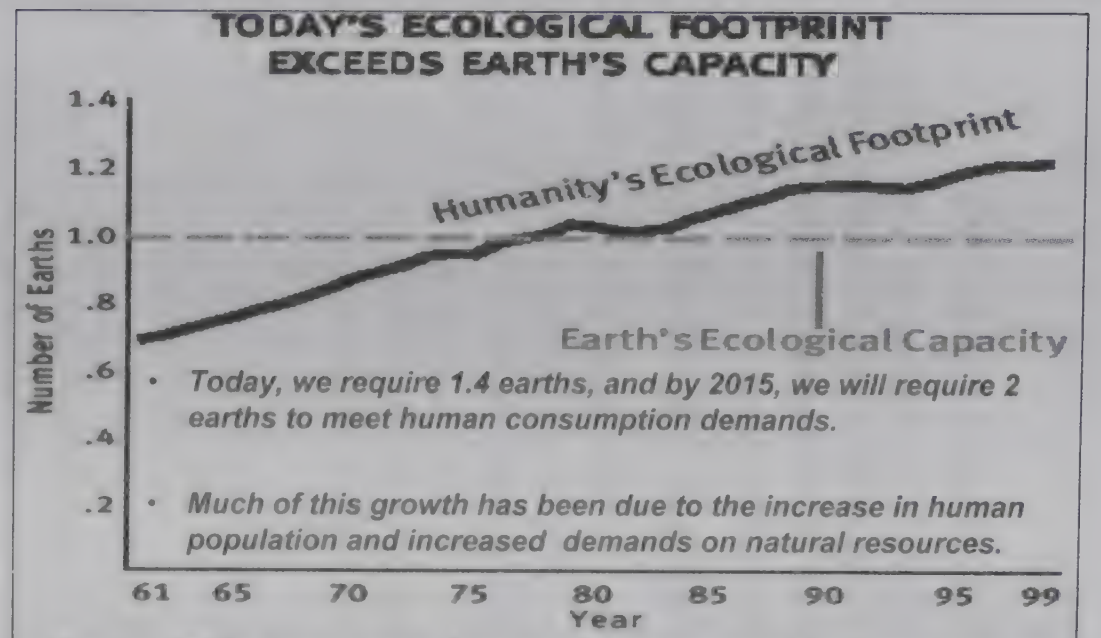
Credit: Press-Office City of Munster, Germany

Oil discovery peaked in 1962. Current consumption is 6 barrels for every barrel discovered.





A projection of future oil supply past 'Peak Oil'



Humanity's consumption and waste production today exceed the Earth's capacity to create new resources and absorb waste. We are currently liquidating natural capital to support current resource use, reducing the Earth's ability to support future life.

Energy loss around 1,000 MW Nagarjuna PP

- PP capacity = 1000 MW = 10^6 KW (KJ/sec)
- Energy produced/hr = 10^6 KWH (unit)
- 1 unit = 3.6×10^6 J
- Energy produced/yr = 10^6 KWH x 24 hrs/day x 300 days/yr = 7.2×10^9 units = 2.592×10^{16} J = 2.592×10^{13} KJ

- Energy loss in 25 km radius = energy loss in plant area + energy loss due to crop yield loss
- Plant area = 4 sq km
- Energy loss in agricultural lands = 3000 kcal/m^2/yr = 3000 x 4.2 KJ/m^2/yr = 1.26×10^4 KJ/m^2/yr
- Energy loss in plant area = 1.26×10^4 KJ/m^2/yr x 4×10^6 m^2 = 5.04×10^{10} KJ/yr
- Energy loss in 25 km radius (taking only half the area of a circle of R 25 km) = 1.26×10^4 KJ/m^2/yr x 0.3 x 1000 km^2 x 10^6 m^2/km^2 = 3.78×10^{12} KJ/yr
- Total energy loss = 5.04×10^{10} KJ/yr + 3.78×10^{12} KJ/yr = 3.83×10^{12} KJ/yr
- **ie. ~15% of energy produced by the PP is lost by local farmers as net primary production on agricultural lands. Net primary production of fisheries needs to be computed.**

Discussion:

Q Air quality standards are set but in vain, very few are monitored. Very few follow the health risk assessment. Please comment.

A *Standards indicate where we stand and help draw an action plan. It is very difficult to take action without standards.*

We don't require pollution control boards what we need is a pollution prevention board. Many petitions have been sent to the prime minister to reduce pollution.

Ambient air quality data collected has not been compiled and no statistical work is done. Automatic ambient air quality stations we have is an expensive technology which isn't being used properly.

Air pollution must be traced to its source and prevented there.

Plenary Session 4:

Panel discussion: What more do we need to do to win the war against air pollution in Bengaluru?

Moderator: ***Mr S K Gupta***
Indian Association of Air Pollution Control

Panelists: **Mr H Srinivasiah**
Factories Inspectorate
Government of Karnataka

Mr Arvind Jannu
Department of Environment and Ecology, Government of Karnataka

Mr P H Rane
Traffic Department, Bengaluru Police

Mr Govinda Raj
Bruhat Bengaluru Mahanagara Palike

Dr Jagdish Chinappa
Indian Association of Pediatrics

Mr V N Subba Rao
Karnataka Media Academy

Mr S K Gupta, *IAAPC*

It is unfortunate that there is thriving business in the name of pollution awareness. Controlling and managing pollution lies in the hands of the public but it is a business for those who can take advantage of the public. Lawyers have minted money by fighting on behalf of industrial houses in PIL cases. There is a war between the lawyers of public and lawyers of industries and the former are the losers. It is people like doctors and professionals who can create effective awareness. Public support can reduce air pollution not only in Bangalore but at the global level. If we can ensure partnerships between UNEP and local organizations, we will not be fighting a lonely battle.

Dr Jagdish Chinappa, *Indian Association of Pediatrics (IAP)*

Children are affected by emissions from transportation by vehicles that emit carcinogens. IAP carries out programme where we look into the health of students along with transportation and indoor air pollution issues. We suggest that rain water seeping areas be cleared and kept dry to avoid diseases. We promote the use of bicycles and suggest that areas adjacent to schools be made traffic free for certain durations.

In 1994, the number of children affected by air pollution at the foetus stage and born spastic, in Delhi, was 5000. After 14 years today it is 75,000. There is a definite impact of air pollution on the new born. In my opinion only greater awareness can improve the situation. Patients and others that you come in contact with lack awareness. Since children are the best learners and can take the learning to adults at home, it is best to start in schools.

Secondly there should be a change in people's attitudes. They should consider what they as individuals can do and not depend on the government to reduce air pollution.

IAP is willing to help in talking to children and parents to give them more knowledge on the issue. In the case of diseases like Diabetes and HIV, hospitals display preventive measures but when women go for their pregnancy check ups they remain unaware of pollutants that affect the foetus and the new born. Unless people are informed and begin to understand that children can become spastic because of pollution there will be no change. There should be a focus on conveying this to mothers.

Other panel members were not present

Discussion:

Q Some highly polluted cities have oxygen banks. Since children are the most exposed, special preventive provisions must be made for them. Adults should carry asthma relief sprays. Perhaps Bangalore too should have oxygen banks?

A *Oxygen banks are only helpful in raising energy levels of adults. For children, schools should have provision for experienced nurses to attend to affected children.*

Comments:

The war againist air pollution requires the use of administrative and engineering controls: the former are cheaper and easier to impliment than the latter. For example, increasing the number of one-way streets, banning private vehicles in certain parts of the city's central business districts. Creating dedicated cycle lanes, empowering communities to take decissions that will help reduce pollution exposures in their neighbourhoods, can immediately reduce air pollution related health effects.

Apart from awareness, policy tools must be made available to the masses. Neighbourhood schools should be promoted.

The option of better and extensive public transport systems may also be considered. Cities in Japan have better air quality through public transportation rather than through restricting mobility. It is not Bangalore alone that needs to be considered. In saving Bangalore we might end up polluting the rural sector. Holistic examples must be taken into account.

KSPCB's pollution monitoring and control have revealed that particulate matter is not responsible for air pollution. Far more responsible are the carcigenous gaseous components of emissions. Even with advanced monitoring techniques we have unfortunately not been able to co relate pollution and health risks in public perception. KSPCB has monitored Ozone. The medical sector says that ozone is above threshold levels. We have not been able to move forward at all. In this forum where there is a possibility of direct action, all this should be discussed

In order to manage air pollution one must think locally. We can take global examples but the management has to be at the local level. We must develop guidelines and strengthen those. Action strategies must be worked out. The whole city should work on developing and controlling monitoring mechanisms of air quality. When we work seriously at the local level we will have the support of UNEP

Breakout Sessions:
Methodology for breakout sessions

The sequential steps followed in preparing the action plan are given below:

Visioning: Individuals spelt out their vision of what specific improvements they wish to see in place in future for the issue they were dealing with. Vision ideas were then clubbed by major heads. They were classified as Short term, Medium term and long term.

Present status: In the next step, each group spelt out the present status of each issue.

Desired action: In the third step each group worked out the action that is required to go from the present status to the vision they have spelt out.

Multi voting: In the last step vision ideas were ranked by a process of multi voting.

Workshop participants were divided into four groups to prepare action plans. Trained persons facilitated the discussion in each group. The members of each group are listed below.

Group 1: Health Effects Management for all Spaces

Facilitators: Athar Qureshi, Priya Patel.

Members: SS Rao, Nikhil Desai, Bhavana Kaveti, Puja Thakker, Venkatachalam, Jayachandra, Shobha, Ramesh, Vishwanathan, Christi Dominic Savio, Shukla, Bobby Joseph, Chandrashekhar, Shashi.

Group 2: Ambient Air Quality Management

Facilitators: S K Gupta, C J Chander.

Members: Soumya Dutta, Ramesh Agarwal, Rajendra Prasad, Gopinathan, Prashanth, Subhash Babu, Rahul, Jyothi, Sabbir Ali Khan, Ramachandra, Uma Rajarathnam, Suresh, Paramesh, Prabhu Rajendran, Kiruba Shankar, Sampath, Janet s k, Sesha Prakash, Sathya Prasad.

Group 3: Air Quality Management in Work and Indoor Spaces

Facilitators: Vinay Kumar, Sukanya Rangamani, Cyril Fernandez

Members: Azhar, Veena, Jaya Kumar, Sudhakar, Christopher, Dipanita, Gieish Babu, Nagappa, Bindya, Suguna, Radheysham Balaji, Hita Unnikrishnan, Pal, Dhenuka Srinivasan, Lobo Dorin, David Selvraj, Jagdish Chinnappa, Premlatha, Kamlakar.

Group 4: Community Intervention Programmes

Facilitators: Premdas, Vinay Vishwanath, Paritosh Tyagi

Members: Verma,Rabindranath Biswas, Lazarus Konda, Manisha Ganeshan, Devadhanam, James, Sowbhagya, Anil Derick, Parasuramulu, Chandana, Radha, Manoharan, Vidya Dinker, Sharma, Thomas Thanpaul, Settaiya, Surendra, Rohit, Shashikala Manjunathan, Pratibha.

E-100
10600

Presentation:

A action plans prepared in breakout sessions

Chair: Mr. R. Rajamani

Group 1: Health Effects Management for all Spaces

Present Status	Action required					Vision
	Action steps	Timeline	Target	Ownership	Partners	
Decreasing green cover and water bodies in the city	Prevention, Conservation and Restoration of water bodies and green cover (open spaces incl.)	Mid Term 2-3 years	All citizens	CIVIC Bangalore (Mobilization of other groups for the Ad-hoc Committee to be formed)	BBMP/BDA (Town Planning) NGOs/ CBOsResidence AssociationsElected Representations Social Forest Department MediaBusiness and Industries	An Eco- Friendly Bangalore
Lack of multi-sectoral approach and people's participation in Urban Planning	Advocacy for participation of people in Urban Planning and Policy Making	1 year				
Increased use of Fossil Fuel and emissions	Increase public awareness and use of non-conventional or alternative fuels	Immediate to 3 years	All citizens		MediaTransport Dept.KSPCB Industries/Business	A pollution Free Bangalore
Health Inequity- Availability Affordability Accessibility	Advocacy for Health Equity	2-3 years			BBMPDept. of Health NGOs/ CBOs	A healthy Bengaluru

Present Status	Action required					Vision
	Action steps	Timeline	Target	Ownership	Partners	
Low Health Awareness on Air Pollution related illnesses	Increase Awareness on • Cause and Effect of Air Pollution (AP) related illness • Risk factors • Prevention of AP related illnesses • Treatment Options	3-5 years	General Public High Risk Groups like Slum Dwellers/ Children/ Traffic Police/ Construction workers/ Auto rickshaws drivers Parents and Teachers	IAP (Training for Parents/ Teachers) CSI Hospital (School Health) CHCs Radio Station (Fever 100)	MediaState Health Department NGOs/ CBOsDept. of Women & Child welfare Dept. of EducationUnionsTransport Dept.BBMP	
	Training of Health Care providers in diagnosis and treatment of AP related illnesses (customer friendly orientation)			IAP (Training for Doctors and Health Care Providers) Indian Medical Association General Parishioners Association	State Health Department	
Poor Policy Implementation at ground level	To increase accountability and set up a public monitoring groups	2-3 years			Dept. of Public HealthTransport AuthorityBBMP/BDA (Town Planning)NGOs/ CBOs KSPCB	Cutting across above three
Lack of evidence in certain issues and areas within AP related illnesses	To carry out research and data collection, studies in those areas	2-3 years			Research Organizations and Institutes, KSPCB, Hospitals and Medical Colleges PHFI, CHP	
Fragmented Public Participation and short lived campaigns	To mobilize and form a collective group to address the issues as a whole	Immediate to 1 year	NGOs/ CBOs/ Groups		NGOs/CBOs Collective Forums	

Group 2: Ambient Air Quality Management for Work and Indoor Spaces (2 tables)

1. Status table

Present Status	Road Map	Vision
Lack of Awareness About Status and management plan Public information system Scientific terminologies Inadequate air quality monitoring Pollutants (Only NOx, SOx, CO are known) Source contribution Industrial sources ***Lack of urban planning*** Inadequate tree cover Improper maintenance of road Poor connectivity Over crowding of commercial activities in city centers No public participation in urban planning Lack of waste management Power generation using Diesel generating sets not monitored. ***Inadequate Public Transport*** Inadequate policies / incentives / measures to control rapid growth of private and diesel vehicles Inefficient monitoring of vehicular emission tests Fuel adulteration	Development and implementation of Air Quality Management strategies Create awareness and inform public about status of air quality and related information through • Media • Frequent SMS alerts • And involving students and public to create awareness	Clean; Green; Pollution and stress free Bengalooru Aware, informed citizens involved in decision making Efficient public transport and proper traffic management Limited resource consuming city-Sustainable Bengalooru Air quality standard in control

2. Action plan table

Status	Target	Partners	Action Steps	Timeline	Implementers
Lack of awareness	Citizens of Bengalooru	KSPCB MoEF, Municipal corporation Media Research institutes NGO Students Private organizations Corporates Transport owners and association Environmental experts Medical experts Donor funding agencies	Display boards in prominent intersection (minimum 10 per year) Display boards in commercial malls Monthly newsletters Awareness messages through TV, media, radio, newspaper and website Integrated epidemiological source identification study to be taken up	1 year-10 5 years-50 1 year Results to be awaited for 2 years	KSPCB NGOs Educational institutes Media Environmental & medical institutes Mayors / Municipal commissions need to take action / initiations
Lack of planning	Citizens of Bengalooru	Urban development Authorities Corporators Town planners Planning commission Municipal Authorities	Integrated township to be promoted	Long Term	Urban development authorities

Status	Target	Partners	Action Steps	Timeline	Implementers
Inadequate public transport	Transport Authority	Urban Development Authority Forest Department NGOs Students Resident Welfare Associations	Increase tree cover by 10% of present cover in 5 years Strengthening Public transport Better Road and traffic management Promote neighbourhood school policy Promote cleaner fuels Proper inspection and maintenance Point to point pick up services from public transport places like railway stations and bus stops Increase tree cover by 10% of present cover in 5 years Identify trees that needs less maintenance and are locally suitable • Ban cutting of trees. In unavoidable situations plant 25 trees for 1 tree cut and take care • Tree guards can be appointed for taking care of trees • No of buses to be increased minimum 20% • All schools, colleges and staff should have buses • Phasing out old vehicles (more than 15 years)	Immediate	In 1 year 2 years Continuous action to be started

Group 3: Air quality management in work and indoor spaces

Present Status	Action Plan	Vision
A 1. No fundamental data on level of air pollution in indoor spaces. 2. In addition no protocol too. • Health risks • Burden on Government & labourers	Need Legislative action, empowering a work committee; Need to amend factories act. Need of a policy to register all industries no matter what size	Should be total & complete awareness. Intervention at the planning level itself
B There are no standards for levels of pollutants, not applicable to Indian Government.	Advocacy campaigns by public.	A database should have been created.
C Workers not provided with safety gears in garment industries, chemical industries, etc.		
D Lack of awareness	Create awareness: • Industry specific workshops informing workers on international norms, exposure measurement, safety regulations. • Simple do's & don'ts fact sheets. • Street plays, news paper articles, documentaries, radio shows – to create awareness among public.	
E Regulatory authorities lack proper human resources		
F No simple tools to measure air pollution in indoor spaces.	Studies should be carried out & a database should be built.	Regular & intensive monitoring by respective offices.
G Labour department have no skills to handle safety mechanism & chemicals being handled.	Estimation of diseases in different workplaces should be done. Plant trees.	

Group 4: Community intervention programmes (4 tables)

1. Proposed steps table

Vision: Bangalore should be seen as a garden city	
Empowerment and awareness	i. Let the community evolve or transfer and empower. ii. Set their own norms vis-à-vis air pollution related health risks. iii. All the families in Bangalore should be aware of air pollution. iv. Synergy among various departments dealing with air pollution and community welfare. v. Information should be readily available to the general population. vi. The community intervention could be in the form of eyes and ears of control regulations so as to bring facts before thee public and community.
Industrial and high risk groups	i. Garment workers must be away from asthma and TB. More regulation and safety standards. ii. Control equipments should be provided. iii. Women and children have to be taken care. iv. Quarry workers should be aware of health problems related with air pollution and use appropriate low cost materials like waste cloth to prevent inhalation of dust. v. Provide hygienic conditions for quarry workers. vi. In railway platform: proper maintenance, proper sanitation, general awareness among the people to keep neat and clean, penalty must be imposed and cooperation from people and government.
Civil society/citizen/ community participation	i. Every project and plan is known to people & people have opportunity to discuss with each other and with project prevent. ii. Community participation across and the city into envisioning & evolving a better transportation system that works for everyone and less polluting and stressful.
Regulation and management	i. Human right is to live happily. ii. Poor should be given house plots. iii. Air pollution should be prevented; private sectors should obey the rules. iv. Community awareness on indoor air pollution. v. Personal protection among quarry workers. vi. Periodic medical check-ups in work places and better waste management. vii. Avoid incineration. viii. Hygiene and education for the workers should be provided.

2. Status table

Industrial & other high risk groups	i.	Slum maintenance in Bangalore is bad, no proper facilities; area for cooking & disposal are next to each other; foul smell in the slums.
	ii.	People are well aware about the cause but they are lazy and ignore.
	iii.	Railway – they are still dirty with sanitation in waiting rooms and rest rooms. Plastic products are badly used & thrown everywhere.
	iv.	Waste disposal in urban areas is extremely disheartening slums; waste are dumped in one bin; no proper disposal is provided.
	v.	Air pollution is increasing in Bangalore due to the increasing number of vehicles, setting up of factories and new industries. Asthma is rising due to the increase of particle matter and other dirt.
	vi.	Unhygienic surroundings & uncontrolled attitude of quarry owner, no government & authority intervention; Bangalore city's condition is going from bad to worse.
	vii.	Status in industrial sector – workers in electro plating, smelting and other carcinogen of other unknown composition. Government agencies do not have adequate monitoring mechanism and an easily accessible data base is missing.
	viii.	Living in the midst of dust and smoke due to blasting .living near disposed city-waste/garbage. Not bothered about respiratory problem and only accidents are considered as health problems.
Public awareness and community participation	i.	Peoples environment impact assessment (EIA of the projects are not to be done)
	ii.	The Bangalore city is growing above and higher and higher and it is straining the resources available at the base
		PUBLIC HAS PARTICIPATED AT BANGALORE IN THE FOLLOWING WAYS
	i.	Vigilance by NGO's
	ii.	PIL
	iii.	Well-based awareness generation
	iv.	Represent people in public hearing on projects in environmental clearance
	v.	No awareness programmes through mass media like TV, radio and newspaper regarding hazards of air pollution
	vi.	No strict regulatory strategies for air pollution at industrial, traffic and other work places
	vii.	No community participation in terms of prevention of air pollution because of lack of awareness
	viii.	No health care facilities at govt. level to tackle the hazards of air pollution
	ix.	In schools not only awareness and class room education but practical use is also being told
	x.	Improper waste management
	xi.	Educating the lowest people and involve them in participation
	xii.	People's participation is also increasing in Bangalore so encourage them.

Urban planning and management	i. Not able to recognize the draw backs of a fast growing city. ii. Negligence on peoples part iii. Indoor air pollution in houses and work places are unregulated iv. Improper public health system v. No civic communities for upcoming layouts vi. Urban town planning without community participation
Database on air quality and co-relation on health status	i. Scanty data ii. No correlation between air quality and health problems
Rules and regulations	i. Law is not being implemented and rules are not checked ii. Unorganized sectors like quarry workers are not given importance

3. Action plan table

Raising awareness	i. In local language ii. Establishment of peoples forum iii. Generate database on air pollution level and analysis of the same iv. Organize awareness programme in the year of planet earth v. Through media expose responsible people vi. Funds to be taken from international agencies vii. Formation of environmental support groups among stake holders viii. Lobbying and expansion ix. Identifying key partners x. Indoor and outdoor air quality monitoring xi. Awareness to slum people xii. Strict laws to be implemented
Community participation	i. Collect samples by NGO's ii. From neighborhood committees and learn to monitor and report to concern dept. iii. Conserve water and electricity iv. Manage solid waste including domestic through resident welfare associations. v. Volunteers act like environmental wardens
Others	i. Health care facilities and tackling by govt. and private hospitals ii. Low cost methods and act.
Indoor management	i. Cleaner house and pets ii. Pollen management from house plants
Industrial management	i. Educate the owner ii. Prevention and control in the source iii. "Maternal leave" to be increased

Urban planning	i.	Waste management no incineration, but composting units
	ii.	Separation of plastic
	iii.	Encourage recyclable and bio-degradable waste
	iv.	Traffic-adequate public and govt. transport than private. Speed of metro and mono rail work build wider pavements and bicycle lanes
	v.	Discourage private vehicles
	vi.	Industrial zone required
	vii.	Impose strict penalties when violated
	viii.	Threshold should be set up for air pollution by KSPCB
	ix.	Bio-fuel vehicles should be increased
Rules and regulations and database	i.	Impose rules to be strictly followed
	ii.	Online monitoring system to be installed
	iii.	Stringent action against polluters
	iv.	Emission testing
	v.	Knowledge of pollutants in work place
	vi.	Electric cars and bicycles to be encouraged
	vii.	Suggestions to be taken by people in KSPCB

4. Responsibilities table

Action	Partners	Responsibilities	Facilitators
Raising awareness • for quarry workers & owners • for people suffering from asthma • IEC materials • technical support for industrial sector • education & awareness in slums • for garment workers & owners	KRVP QWARIDS CM dept. of KIMS CM dept. of Rajarajeswari medical college St. Martha's Hospital CH dept. GWU	For IEC materials /HEResource person	Mr.Manohar Dr.Parasaramulu Dr.Shashikala Dr.D.C.Sharma Dr.Soumya/Pratibha Ms.Sowbhagya
Building capacity if NGOs / CSOs/ Movements working with on environmental issues	Dept of science & technology (under planet earth programme)	Constant interaction and capacity building sessions	Ms Vidya Dr. D. C. Sharma
Policy & regulation • interaction with KSPCB • baseline data on air quality	KIMS, RRM CRRMC, ROHC & KSPCB	Policy lobbying Collecting baseline data contacting others Designing studies	Ms Vidya Dr. Sashikala Dr. DC Sharma
HIGH RISK GROUP • Quarry workers environment safety committee • G.W. for safe working conditions • health risk and occupational health assessments	QWARDIS GWU RRMC	Improving working environment Field appraisal visit	Mr. Manohar Ms Sowbhagya Dr. Shashikala

Valedictory Session

Chair: Mr R Rajamani

Retired civil servant, MoEF

In the plenary session on presentation of plans and closing session, Chairman R.Rajamani complimented the organisers, especially KPCB and Cerana Foundation, and participants for the success of the workshop and high level of discussion in various sessions. He emphasized the need for continued focus on environmental health in the present situation of continuing economic growth and consumption of natural resources whose flip side were the adverse effects on human and animal health. This workshop, like the one earlier in Mumbai convened by Cerana Foundation highlighted the need for early measures to tackle the problems like childhood asthma triggered by air pollution. There was need for continuing epidemiological studies to bring to the notice of policymakers the dangers of air pollution and need to take both preventive and control measures to reduce air pollution. Simultaneously, doctors , patients, industry and society in general should act to prevent the ill effects on health and this meant raising the level of awareness as discussed in the workshop. It was a happy augury that in Bengalooru such a high degree of sensitivity has been shown not only by UNEP, doctors, citizens and NGO's, but also by regulatory and policy making agencies like the State Pollution Control Board and the Ministry of Environment. It was a very good move to set up a continuing mechanism for coordination of follow up in Bengalooru and he wished it all success.

Mr Mylvakanam Iyngararasan, UNEP

Mr. Mylvakanam Iyngararasan of UNEP expressed the satisfaction that the workshop has established the much needed collaboration among the stakehokders on health impacts of air pollution in Bangalore. He informed that UNEP will continue to support the initiate and believed that the network established in the workshop will continue. He thanked the organizers for convening the important workshop on health impacts of air pollution, one of the major environmental issues in Asia.

Dr H C Sharatchandra, *Chairman,* KSPCB

Bengaluru has done well for itself economically. But this has come at a cost. Bengaluru's air pollution problems have multiplied manifold. It is time for Bengluru to pay serious attention this problem.

I am happy that Cerana Foundation and KSPCB collaborated with 16 co-sponsors to put together this workshop so very successfully. I also wish to than UNEP for sponsoring this workshop and encouraging a partnership approach between risk bearers and other stakeholders.

The task of taking the recommendations forward as practical programmes challenges us. I hope that a committee is formed at the earliest opportunity to implement the workshop recommendations. KSPCB will cooperate fully with this committee to tackle air pollution health effects in Bengaluru.

T. Vijayendra, *Chairman,* Cerana Foundation
Vote of Thanks

Mr. Chairman and Participants,

It is my pleasant duty to thank you all for the successful completion of the workshop.

In a workshop like this many unseen hands and persons contribute invaluable work. So let me begin with 'Unto the Last'.

Members of the staff of the Pollution Control Board, Karnataka have been extremely cooperative with the outstation workshop team that arrived some 10 days before the workshop began.

A very special mention must be made here of Mahalakshmi who for months has single handedly coordinated practically all the aspects of the workshop at the Bengaluru end.

I wish to thank the volunteers who put in so much hard work with so much cheer. They have

been with us in the days leading to the workshop and will be there when we are packing up.

Thank you, Gopal, Hredai and Subramaniyam.

Let me also thank the reporters whose work will make the writing of the report that much easier. They also doubled as volunteers on many occasions. Thank you Madhumita, Srinidhi Kasyap, Swapna, Shwetha of St Joseph's College, Bengaluru and Reshma Naveen Khan, Javeria Fatrhima Ikrani, Pallavi Hittanagi, Madhushree, Roshni Yathiraj, Swapna Nayak, Yogitha Babu from Mount Carmel College, Bengaluru.

We have been very fortunate to get a large number of co-sponsors. The Bangalore based co-sponsors particularly have been very helpful. The pride of place among them of course goes to the Pollution Control Board, Karnataka who have given us the workshop venue and helped us in every possible way. I wish to thank all the co-sponsors whose names I will read out.

Central Pollution Control Board, Indian Association of Air Pollution Control, Public Health Foundation of India, Bruhat Bangalore Mahanagara Pallike, Bangalore Medical College and Research Institute, Community Health Cell, St John's National Academy of Health Sciences, Voluntary Health Association of Karnataka, Indian Academy of Pediatricians (Karnataka Branch), Centre for Research on Environment, Development Innovations, Technology and Trade (CREDITTe), Janjagruthi Samithi, Samarthan, Church of South India

Hospital, Institute of Leadership and Institutional Development, Indian Association of Occupational Health (Karnataka Branch), Quarry Workers and Rural Integrated Development Society.

Finally I would like to thank UNEP who have funded the workshop and in particular Mr. Surendra Shreshtha and Mr. Mylvakanam Iyngarasan who have come all the way to attend the workshop.

Then there is always this 'last but not the least' person. I thank Bhashwati who managed every thing that needed to be managed wherever and at whatever time!

Finally there are my colleagues, Radhika and Sagar. But they pointed out to me that it is not the done thing to thank ourselves. Besides, whenever anything goes wrong we have ourselves alone to thank. So let us leave at that...

I thank you all once again and have a pleasant and safe journey back home!

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Shop floor exposure to air pollutants

Vehicular pollution on a Bengaluru road

Municipal waste dump, Govandi, Mumbai, with slums next-door

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